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Nvidia RTX 5080 tested
Is it worth the mighty price?

INTEL'S B580 GPU
A REAL CONTENDER FOR YOUR GAMING?

2025 Australian PC Awards finalists revealed!

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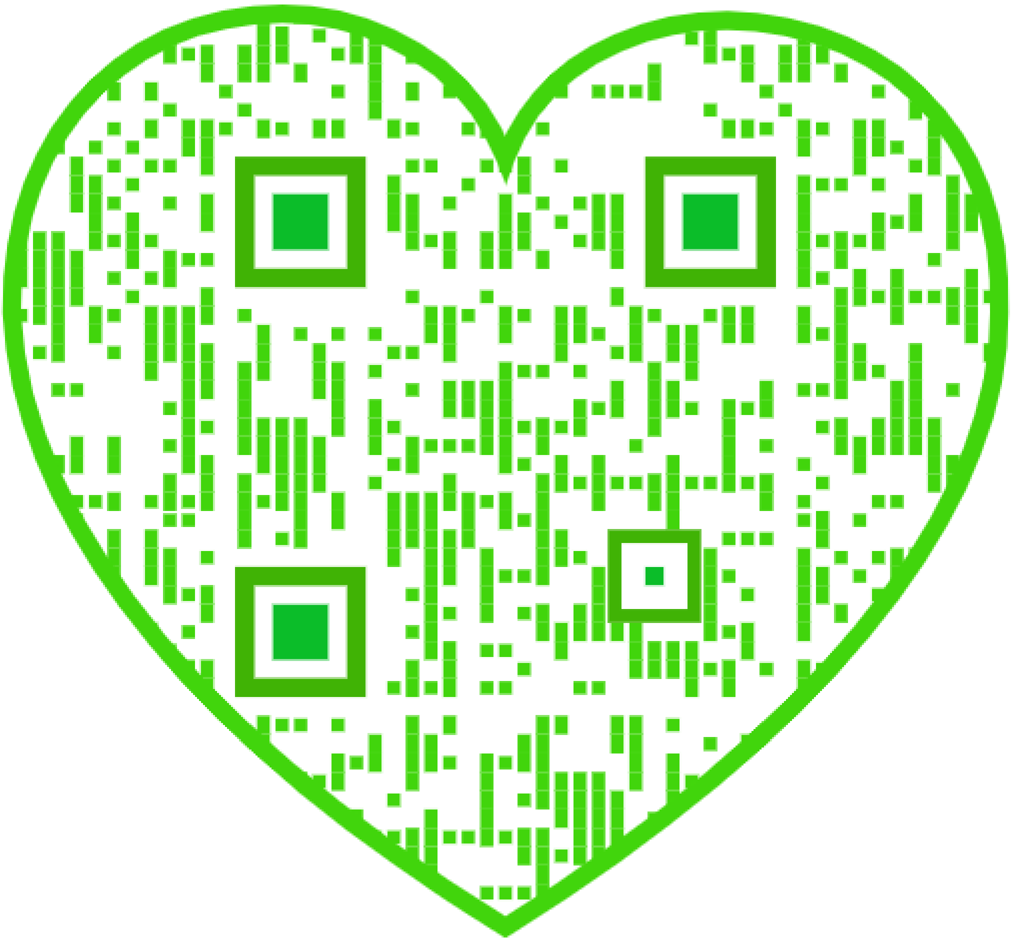
HOW TOs

CREATE YOUR OWN AI IMAGES
HAVING FUN WITH THE IMAGE PLAYGROUND APP FOR MAC

BE A PRO CREATOR
VIDEO FORMATS & CODECS DEMYSTIFIED

GAMING

The evolution of video game AI
HOW THEY MAKE THE MONSTERS SEEM REAL



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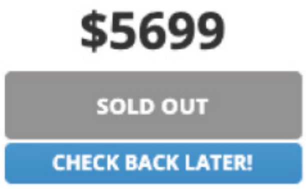
“Sold out”

Nvidia’s paper launch.

Here we are, reviewing the new Nvidia cards. As we do, because graphics cards are core to PCs and the arrival of a new GPU is usually cause for much excitement in our world.

Except you can’t buy them. They’re “not available” anywhere you look. Then there’s the pricing… a top-end 5090 is almost $6,000. What? And, if you do manage to get one, it might catch fire and burn your house down. That drama covered on page 8.

What a disaster. This is a paper launch, there’s no doubt about that. I’ve been checking the major reseller sites daily since they were listed, and not once have I ever seen any 5080 or 5090 listed that was actually in stock. Heck, Scorptec appears to have given up completely, or are taking the piss – every single 5090 on their store page is listed at $6,999, and is “sold out”. Well, I don’t think they were sold out, it’s clear the resellers never had any serious stock to begin with. And it’s not because we lucky reviewers have all the cards – the struggle to get review cards for this issue of *APC* has been unbelievable. It seems that there’s just one or two samples in the whole country for some partners, and the PRs have been doing their best to efficiently shuttle these samples around to all the media. Some have been delivering the cards personally the moment they arrive in the country because it’s quicker than booking a courier. It’s madness.



We’re not blaming the partners like MSI, Gigabyte and Asus. They can only work with the GPUs they get from Nvidia, which isn’t many. Nvidia partly blame Chinese New Year factory shut downs, which is bollocks. CNY has never affected product launches meaningfully before. It’s not TSMC’s fault either. They build to order, and Nvidia wants the AI chips that have propelled the company to unfathomable wealth rolling out of the fabs instead.

Then there’s the power cable fire hazard, which is an issue that Nvidia needs to address urgently. But it can’t without a connector redesign, or reverting back to multiple old-style 6-pin or 8-pin plugs, which are safer.

What a complete mess. AMD is set to capitalise, but will it? The Radeon 9070 and other Navi 48 cards are due imminently. AMD would do well to offer unbeatable and sane pricing, and ensure wide availability. That’s really the only hope consumers have right now. The alternative is to just wait, or skip this graphics generation completely.

Anyway! The situation will eventually return to normal once supply increases. Until then, enjoy our reviews and let’s hope the 5070 launch fares better! ■

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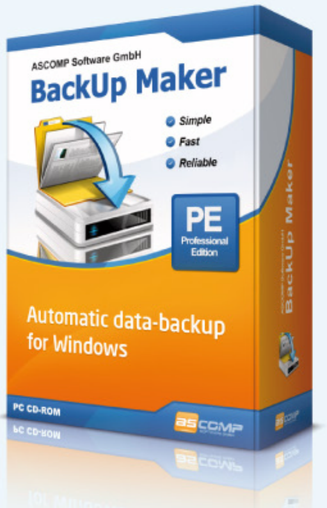

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CONTENTS

This month in *APC*

38

36

39

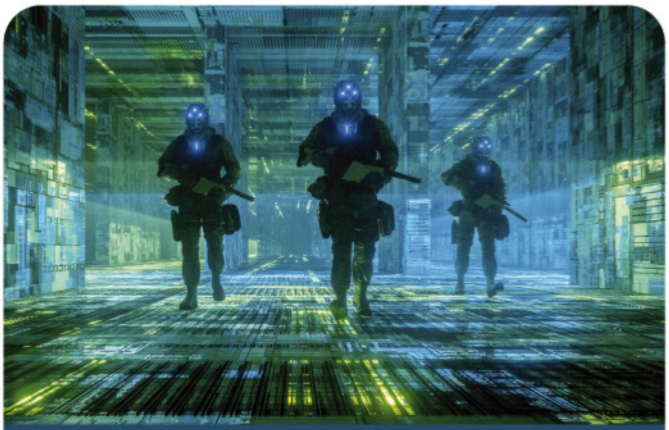
2025's HOTTEST LAPTOPS

What's new & what's coming

50 Plus 44 other releases! We pick the 56 standout products and new technologies from this year's CES.

PART TWO
PART 1 APPEARED IN ISSUE 542

74 **The ultimate Windows 11 install guide**
Install our favourite OS like *APC* veteran Zak Storey does it.



64 **The evolution of video game AI**
Over time, game AI has become more refined.

> **"Now anyone with a smartphone can be a social newscaster; the previous true professionalism, where cost and effort has gone into training journalists, has been replace by the faux professionalism of a slickly made video that anyone can create."**

Jon Honeyball - **One More Thing**
page 17

INSIDE

Technotes

08 News
Stay up to date with all the important news in tech

10 Tech brief
Meta torrented 82TB of pirated books to train AI models

14 End user
Kotick says Microsoft isn't a 'creative' company

15 Tech talk
Nvidia RTX 50-series pushes AI to the forefront

16 Trade chat
Fun and graphics card games at CES 2025

17 One More Thing
It's time for a zero-trust approach to "news"

20 Futures
Why the sci-fi future we live in is disappointing

26 A-list
The best products on the market as rated by the *APC* team

29 The List
The best laptop graphics cards

30 Head to head
X vs Bluesky

32 Gadgets
New things you don't really need but will surely want

The Lab

35 Intel B580
36 Asus ROG Swift OLED PG27UCDM
37 Lemokey G1
38 Asus RT-BE92U
39 Asus ROG Pelta headset
39 MSI Datamag Magnetic Portable SSD

The Lab Feature

40 Nvidia 5080 group test
42 Asus ROG Astral GeForce RTX 5080 16GB GDDR7 OC
43 Aorus RTX 5080 Master
44 MSI RTX 5080 16G Suprim SOC

Software

46 FotoSketcher 3.97, PhotoDemon 24.12, PDFgear 2.1.10
48 Stuff, ToDos and Lists
49 GhostBSD 24.10.1

Features

12 Awards finalists
50 Best of CES
64 The evolution of video game AI
70 Video formats decoded
74 The ultimate Windows 11 install guide part 2

PC Builder

80 System news
Looking into a Black Well of expensive GPUs?

81 Market watch
A sampling of PC systems currently available

82 Blueprints
Value- and performance-driven hypothetical builds

How to

86 Q&A
88 Boost your Wi-Fi
90 Expert tips for Windows
91 Make Office better
92 Browser tips
94 Create your own AI images
96 Hide vital information
98 Do more with your smartphone
100 Capture images and video with Picamzero

Downtime

102 Gaming reviews
High-performance playtime

106 Game changer
Remember Me

110 Retro
Using old computers for new tasks

114 Know How
Deep clean your Facebook account

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TECHNOTES

Everything you need to know from the month in tech

Nvidia's RTX 5080 & 5090 power cables may be doomed to burn

16-pin ports are over-rated and under-protected by design.

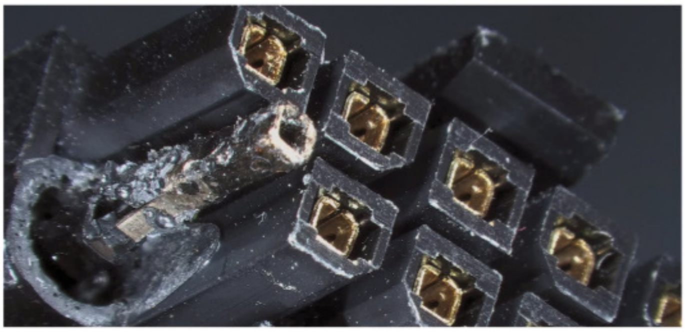
As the RTX 50-series rollout continues, users are experiencing what seems to be a shockingly high rate of failure. The proprietary 12VHPWR/12V-2x6 cables providing power to the graphics cards have been seen melting inside the GPU slot of 5090 and 5080 cards. Nvidia was confident that users would no longer see the same issue that also plagued the RTX 4090 thanks to the redesigned 12V-2x6 connector, but multiple sceptics are asserting that Nvidia is making its cards less safe with each generation.

Nvidia has consistently removed safety regulations like shunt resistors from its cards generation-over-generation, contributing to a high risk of burning and other dangers. Shunt resistors on GPUs monitor the flow of power from the cable and ensure that there is no overload. A 30-series and earlier Nvidia GPU would have multiple shunt resistors measuring current, allowing the card to balance its load by regulating power draw across each power connection. On cards using 8-pin and 6-pin power connections, a typical GPU has a shunt resistor for each plug. On the 30-series, Nvidia treated its 12V connector as three parallel 12V sources, allowing for regulating the power draw across the wires in the single connection.

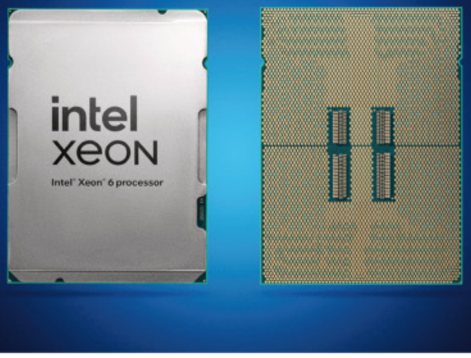
On the 40- and 50-series cards, however, Nvidia downsized to two shunt resistors running into the same block. This means that even if there are two resistors, they both are received in the same input and in the same phase by the GPU, thus meaning the GPU cannot measure the flow across the connection. If anywhere from one to five wires break in the connection, the card will not know the difference.

With the max spec of the 12VHPWR connection being 600W, a cable with up to five wires broken could go from six wires pulling 100W each to one wire pulling 600W, resulting in a major problem. The card has no safety tools to know the difference and fire could break out.

Some aftermarket cards, such as the Asus ROG Matrix 4090 and Astral 5090, add a secondary bank of shunt resistors before the consolidation of all of the pins. While the same bottleneck still occurs and power draw cannot be regulated appropriately in case of failure, the card can send a warning to users before a catastrophe occurs.



u/ivan6953 / Reddit, Der8auer



Intel data centre CPU sales hit the lowest point in 13 years

AMD OUTSELLS INTEL IN THE DATACENTRE FOR THE FIRST TIME.

Sales of Intel's data centre CPUs in 2024 hit their lowest level in more than a decade due to increased competition from AMD, the transition to higher-core count models amid a drop in the number of CPUs, and a market shift to AI servers that use up to eight GPUs and just two CPUs. Unit sales of Intel's data centre CPUs in 2024 dropped by 20% from 2011 levels and over 80% from 2021.

However, in 2022, demand for general-purpose servers slowed down while AMD unveiled its 4th Generation Epyc processors with up to 96 cores, far exceeding the number of cores in Intel's top-of-the-range Xeon CPUs. As a result, the blue team's unit shipments dropped in 2022 and then collapsed in 2023.

PhysX quietly retired on RTX 50 series GPUs

DIGITAL KILLING OFF THE LAST REMNANTS OF PHYSICAL MEDIA.

Nvidia has quietly retired 32-bit PhysX support on RTX 50 series GPUs – a game-specific graphics technology that was advertised heavily during the 2000s and early 2010s. PhysX is one of the oldest Nvidia technologies, almost rivalling the age of CUDA itself. PhysX was a proprietary physics simulation SDK capable of processing ragdolls, cloth simulation, particles, volumetric fluid simulation, and other physics-focused graphical effects.

As far as we know, there are no 64-bit games with integrated PhysX technology, thus terminating the tech entirely on RTX 50 series GPUs and newer. RTX 40 series and older will still be able to run 32-bit CUDA applications and thus PhysX, but regardless, the technology is now officially retired, starting with Blackwell.

HP acquires Human Ai

GIVES THE AI PIN A HUMANE DEATH.

Humane AI Pin's short, bumpy ride is over. HP announced on February 18 that it was acquiring the company and absorbing some employees for US$116 million.

HP notes that it will "acquire key AI capabilities from Humane, including their AI-powered platform Cosmos, highly skilled technical talent, and intellectual property with more than 300 patents and patent applications." It makes no mention of hardware.

Humane AI was a fascinating wearable AI computing device that arrived in November 2023. Instead of a screen, the device featured a camera to watch your world and a tiny projector; you held out your hand and could see little messages and information from the pin. You interacted with the platform through voice and gestures.

SEAGATE
mozaic 3+
EXOS
M

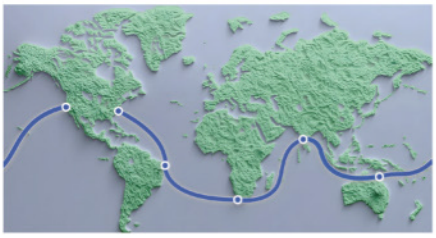
Fraudulent hard drive scandal deepens at Seagate

CLUES POINT AT CHINESE CHIA MINING FARMS.

A Heise investigation of used Seagate data centre-grade hard drives that are being sold as new has suggested that the drives originated from Chinese cryptocurrency mining farms that used them to mine Chia several years ago.

The investigation suggests the used HDDs originated in China, likely from cryptocurrency mining farms that previously mined Chia. During Chia's peak, HDD demand surged, leading to shortages and price hikes. However, the economic payoff for Chia mining declined over time, leading to many farms shutting down and flooding the market with second-hand drives.

According to the report, these drives – many with 15,000 to 50,000 hours of prior use – had their internal records altered to appear unused. Seagate denies involvement; it has launched an investigation and now offers a tool to determine whether HDDs are new or used.



Meta announces plans for epic new undersea data cable

LONGER THAN THE CIRCUMFERENCE OF THE EARTH.

While wireless seems to be the way for everything, the prosaic physical reality that underpins modern comms is that cables carry as much as 98% of internet traffic. Enter Meta's mooted new internet cable, which is planned to be longer than the circumference of the Earth and up to 6.5km down into the sea.

The cable will enter the water on the US eastern seaboard, zip down to Brazil, before tacking off across the Atlantic Ocean and skirting across the lower tip of Africa. From there, it's off to Mumbai, India, then Queensland, Australia before the final, watery trek across the great Pacific to landfall in the US once again on the California coastline.

All in the new cable, which is codenamed Project Waterworth, is planned to be 50,000 kilometres. For the record, the Earth's circumference comes in at just over 40,000km.

Meta describes the new cable as, "a multi-billion dollar, multi-year investment to strengthen the scale and reliability of the world's digital highways by opening three new oceanic corridors with the abundant, high speed connectivity needed to drive AI innovation around the world."

Valve clarifies ban on in-game advertising on Steam

REMINDS DEVS THAT ADS ARE NOT WELCOME.

Steam owner Valve has clarified restrictions on in-game advertising more clearly to help ensure that developers don't think they can get away with posting ad-laden, mobile game-esque slop on Steam, posting that "Developers should not utilise paid advertising as a business model in their game, such as requiring players to watch or otherwise engage with advertising in order to play, or gating gameplay behind advertising. If your game's business model relies on advertising on other platforms, you will need to remove those elements before shipping on Steam. Some options you could consider include switching to a single purchase 'paid app,' or making your game free to play with optional upgrades sold via Microtransactions or Downloadable Content (DLC)." ■

Nvidia, Humane,Seagate, Meta

Meta torrented 82TB of pirated books to train AI models

Employees wouldn't stop emailing each other about it: 'Torrenting from a corporate laptop doesn't feel right'.

The US copyright case against Facebook parent company Meta over its use of authors' work to train large language models has unearthed some embarrassing dirty laundry in discovery. Dozens of emails, allegedly between Meta employees, discuss torrenting massive amounts of pirated material – and seeding those torrents to boot – in order to train the company's AI models.

It was revealed via court documents last month that Meta had obtained AI training data from LibGen, a large file sharing database that includes everything from paywalled news and academic articles, to whole books. The prosecution alleges that Meta downloaded over 80 terabytes from LibGen and another so-called "shadow library" by the name of Z-Library. This is, to be clear, internet piracy on a scale that would make a Nintendo lawyer blush, and the lawsuit alleges the emails put in writing "Meta's decision to take and use copyrighted works without permission that it knew to be pirated, despite clear ethical concerns."

One of the emails in evidence quotes an alleged Meta employee futilely advising that "using pirated material should be beyond our ethical threshold" before arguing that databases like LibGen "are basically like PirateBay or something like that, they are distributing content that is protected by copyright and they're infringing it."

There are repeated examples of emails ascribed to Meta employees flagging the use of LibGen as a concern, either in failed "lone sane man fashion," or in the context of hiding the activity. One researcher proposed only accessing LibGen through a VPN, and later joked that "torrenting from a corporate laptop doesn't feel right."

Meta would ultimately operate in "stealth mode," to quote one AI researcher at the company, concealing the activity by only downloading and seeding the torrents outside official Facebook servers. As an aside: It was real neighbourly of them to seed the torrents too! Wonder how good their ratios were.

The prosecution further argues that these discovery documents suggest that Meta executives up to and including Mark Zuckerberg were aware of the use of pirated material to train AI models at the company. Another detail that stands out to me: The emails filed as evidence indicate that Meta employees believed OpenAI used LibGen for its own models, framing the company's use of the database as a sort of arms race.

If the Internet Archive isn't allowed to loan books as a digital library, I don't think companies like Meta should be allowed to swallow up terabytes of pirated material to train a chatbot that will lie to you about how many planets are in the solar system. In a twist of fate, our international copyright regime looks to be one of the most sturdy bulwarks against an AI future. I'm no fan of the US's Digital Millennium Copyright Act, but I say let them fight.

One other thing I just can't escape is how low-rent this all is: Our Silicon Valley thought leaders and mavericks need unprecedented injections of capital in order to… do internet piracy and conquer a new frontier in cheating on your homework? The sheer body of written communication allegedly confirming it all is just the cherry on top of a schadenfreude sundae.

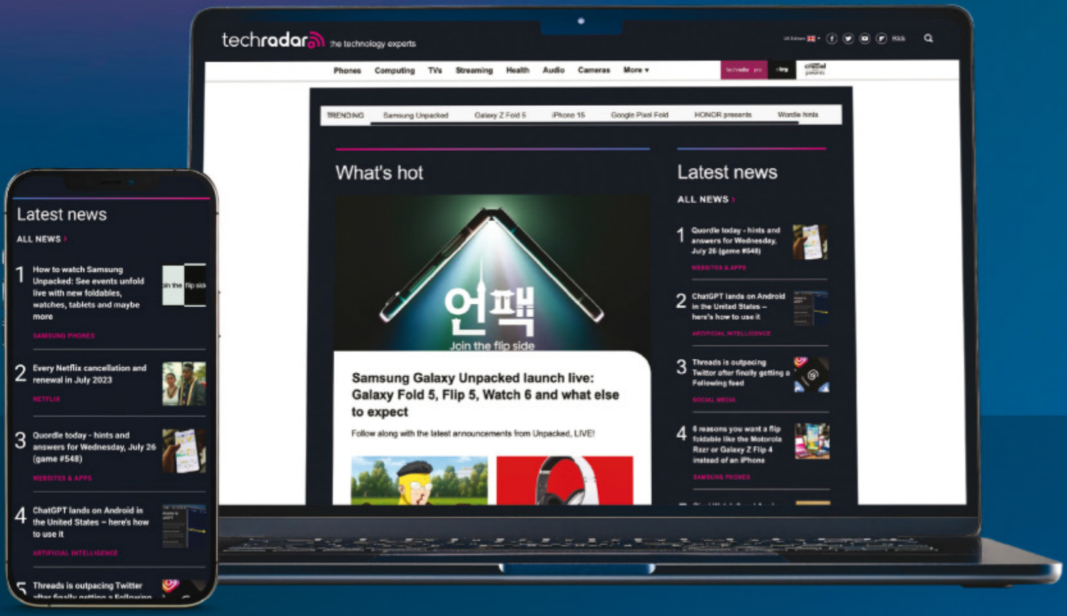
Ted Litchfield ■

Kim is my lawyer

© Meta

> "The prosecution alleges that Meta downloaded over 80 terabytes from LibGen and another so-called "shadow library" by the name of Z-Library."

Meet the technology experts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Samsung Galaxy Unpacked launch live: Galaxy Fold 5, Flip 5, Watch 6 and what else to expect

Follow along with the latest announcements from Unpacked, LIVE!

1 Quordle today - hints and answers for Wednesday, July 26 (game #548)

2 ChatGPT lands on Android in the United States – here's how to use it

3 Threads is outpacing Twitter after finally getting a Following feed

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1 How to watch Samsung Unpacked: See events unfold live with new foldables, watches, tablets and maybe more

2 Every Netflix cancellation and renewal in July 2023

3 Quordle today - hints and answers for Wednesday, July 26 (game #548)

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AUSTRALIAN
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2025 Australian PC Awards Finalists

***APC* decides what the best gear around is.**

It's that magical time of the year – judgement day! The *APC* team, together with our friends and colleagues from *PC PowerPlay*, *TechRadar* and *PC Gamer* have brainstormed over all the products we used and reviewed through 2024, with the goal of coming up with a list of what's better than all the rest.

And that's what we're thrilled to present to you today. In this issue we have all the finalists announced and the big winners reveal will be in issue 544 of *APC*, and on *TechRadar* and *PC Gamer* online.

Motherboards

BEST MOTHERBOARD MAKER

- Asrock
- Asus
- Gigabyte Aorus
- MSI

BEST VALUE MOTHERBOARD

- Asrock B760I Lightning
- Asrock B760M Pro RS
- Asrock Z790 Steel Legend
- Asrock Z790I Lightning WiFi
- Asus ROG Strix X670E-I Gaming WiFi
- Gigabyte Z890 Aorus Elite WIFI 7
- MSI MAG X870 Tomahawk WiFi
- MSI Project Zero B650M
- MSI Z890 Tomahawk WIFI

BEST PREMIUM MOTHERBOARD

- Asrock X670E Taichi
- Asrock X870E Taichi
- Asus ROG Crosshair X870E Hero
- Asus ROG Maximus Z890 Hero
- Asus ROG Strix X870E-E Gaming WiFi
- Asus ROG Strix Z890-A Gaming WIFI
- Gigabyte Z890 Aorus Master
- MSI MEG Z890 Ace
- MSI X870E Carbon WIFI

Graphics cards

BEST GRAPHICS CARD MAKER

- Asrock
- Asus
- Gigabyte Aorus
- MSI
- Sapphire
- Zotac

BEST GRAPHICS CARD

- Asus Dual GeForce RTX 4060 Ti SSD OC Edition
- Asus TUF Gaming GeForce RTX 4070Super OC
- Intel Arc B580
- MSI RTX 4070 Ti Super Ventus 3X
- Sapphire Nitro+ RX 7900 GRE
- Sapphire Pulse Radeon RX 7600 XT
- Zotac Gaming GeForce RTX

4080 Super AMP Extreme Airo 16GB

CPU

BEST VALUE CPU

- AMD Ryzen 5 7600X3D
- AMD Ryzen 7 5700X3D
- Apple M4
- Intel Core Ultra 5 245K
- Qualcomm Snapdragon X Plus
- Best mid-range CPU
- AMD Ryzen 7 9700X
- Apple M4 Pro
- Snapdragon Elite

BEST PREMIUM CPU

- AMD Ryzen 7 9800X3D
- AMD Ryzen 9 9950X
- AMD Ryzen AI 9 HX 370
- Apple M4 Max
- Intel Core Ultra 9 285K
- Intel Core Ultra 9 288V

Storage

BEST INTERNAL STORAGE MAKER

- Crucial
- Gigabyte
- Kingston
- Lexar
- Samsung
- Seagate
- Team Group
- WD

BEST EXTERNAL STORAGE MAKER

- Adata
- Crucial
- Kingston
- Lacie
- Samsung
- SanDisk
- Seagate
- WD

Systems

BEST VALUE OR 2-IN-1 LAPTOP

- Acer Swift Go 14
- Asus Chromebook Plus CX34
- Asus Vivobook S 15 Copilot
- Dell Precision 14-inch 3490
- HP Pavilion 16
- Lenovo IdeaPad Slim 3i
- MSI Modern 14 H

BEST PREMIUM LAPTOP

- Apple MacBook Pro M4
- Asus Zenbook S 14
- Asus ZenBook S16
- HP OmniBook Ultra Flip 14
- HP OmniBook X
- Lenovo Slim 7x
- Lenovo Yoga 7i Aura
- MacBook Air M3 13 / 15
- Microsoft Surface Laptop 15
- Microsoft Surface Pro
- Best gaming laptop
- Acer Helios Neo 18
- Acer Nitro 5
- Acer Nitro V 16
- Alienware M16 R2
- Asus ROG Zephyrus G16
- Asus TUF A14
- Gigabte Aorus 16X
- Gigabyte G6X
- Lenovo Legion 5i
- MSI Titan 18 HX

BEST DESKTOP PC MAKER / RESELLER

- AftershockPC
- Allied
- AllNeeds Computers
- ARC Computers
- BPCtech
- Centre Com
- Computer Alliance
- JW
- MSY
- Mwave
- PC Case Gear
- PLE
- Scorptec
- Umart

Peripherals and components

BEST MEMORY MAKER

- Adata
- Corsair
- Crucial
- G.Skill
- Kingston
- PNY
- Teamgroup

BEST COOLING PRODUCT

- Arctic Freezer 36
- Arctic Liquid Freezer 3 AIO
- Cooler Master Master Liquid 360 Atmos
- Corsair A115 Air Cooler
- Corsair iCUE Link Ecosystem
- Hyte Thicc Q60 AIO cooler
- ID-Cooling Frozn A720
- Noctua NH-D15 G2
- Noctua NH-U9S Chroma Black
- Thermalright Frozen Prism 360
- Thermalright Phantom Spirit 120 EVO
- Tryx Panorama 360 AIO

BEST MONITOR

- Acer Predator X27U
- Alienware 27 AW2725QF
- Aorus CO49DQ
- Aorus FO27Q3
- Aorus FO32U2P
- Asus ProArt Display PA278CFRV
- Asus ROG Swift OLED PG32UCDM
- Asus ROG Swift OLED PG32UCDP
- Asus ROG Swift Pro PG248QP
- Benq XL2546X
- LG UltraGear 32
- MSI MPG 321URX QD-OLED
- MSI MPG 491CQPX 240Hz QD-OLED
- Samsung Odyssey G9 OLED
- Samsung ViewFinity S80UD 32

BEST KEYBOARD

- Asus ROG Azoth Extreme
- Asus ROG Falchion RX Low Profile
- Asus ROG Strix Scope II 96 Wireless
- Asus ROG Strix Scope II RX
- Ducky ProjectD Outlaw 65
- Ducky Zero 6108
- Logitech G Pro X 60
- Logitech G515
- Logitech G915 X Lightspeed Wireless Tactile
- Razer Blackwidow V4 75%

BEST MOUSE

- Asus ROG Keris II Ace
- Corsair M75 Wireless
- Glorious Model D2 Pro
- Logitech G309 Lightspeed
- Logitech Pro X Superlight 2 DEX
- Razer Basilisk V3 Pro 35K
- Razer Viper V3 Pro
- Turtle Beach Kone II

BEST GAMING HEADSET

- Asus ROG Delta II
- Logitech G Astro A50X Lightspeed
- Sony H9 Wireless Noise Cancelling Gaming Headset
- SteelSeries Arctis Nova Pro
- Turtle Beach Atlas Air Headset
- Turtle Beach Stealth 600 Gen 3
- Turtle Beach Stealth 700 Gen 3

BEST CASE

- Antec C8
- Antec Flux Pro
- Deepcool CH160
- Gamemax N80 BK
- HAVN HS 420
- Hyte Y40
- Lian Li Lancool 207
- Nzxt H6 Flow
- Nzxt H7 Flow
- Phanteks XT Pro
- Phanteks XT View
- Thermaltake Tower 600
- Thermaltake Tower 300

BEST ROUTER

- Asus ROG Rapture GT-BE98
- Asus ZenWiFi BT10
- D-Link Aquila Pro AI M30 AX3000 Dual-Band Wi-Fi 6
- DrayTek Vigor2927Lax-5G
- MSI Roamii WiFi 7 Mesh System
- Netgear Nighthawk Tri-Band WiFi 7
- Netgear Orbi 960 Series
- TP Link Archer BE800 Wi-Fi 7
- TP Link Wi-Fi 7 Mesh System BE85
- TP-Link Archer BE3600

Excellence and epic fail

EXCELLENCE

For the person, product or technology that advanced the PC more than any other in 2024.

- AMD
- Apple iPhone 16
- Chat GPT
- CHIPS Act
- Visual Generative AI
- Jensen Huang (Nvidia CEO)
- Lisa Su (AMD CEO)
- Nvidia AI-driven growth
- TSMC

Epic fail

- AMD Ryzen 5900 XT
- Apple Intelligence
- Crowdstrike fail
- Intel 13th/14th gen CPUs failures
- Intel's fall
- Logitech subscription mouse proposal
- Microsoft Recall
- Windows on handhelds

Gold

The company that impressed us the most, overall, in 2024. Every finalist here is a contender for the Gold award!

Kotick says Microsoft isn't a 'creative' company

The huge Redmond corp is too big to adapt as quickly as any creative company must, writes Shaun Prescott.

Former Activision-Blizzard CEO Bobby Kotick gave a frank interview to the *Grit Podcast* last month, wherein he ridiculed former EA boss John Riccitiello and spoke candidly about the sale of Activision-Blizzard to Microsoft.

As some have long suspected, the sale was precipitated by the desire of both Kotick and Microsoft CEO Satya Nadella to purchase TikTok's American interests during the first Trump administration. Kotick had an advantage, in the sense that he was closer to ByteDance founder Zhang Yiming, but Activision's pockets, while astonishingly deep, were not as astonishingly deep as Microsoft's. The solution? Microsoft and Activision-Blizzard combining forces to buy TikTok. The call between Nadella and Kotick to discuss this possibility proved historical for another reason, because that was when the duo first discussed the possibility of Microsoft buying Activision-Blizzard, which it did in short order.

During the recent interview, Kotick had a fascinating anecdote about Nadella, who upon taking on the CEO role in 2014, asked Kotick "what can you tell me about gaming?"

The former Activision CEO replied: "You shouldn't be in gaming. You're not a creative company. You should buy Workday or something, SAP. It's [Microsoft's] not a creative DNA company. And when he [Nadella] called to do the deal I said the same thing to him, I said 'you need us' because you're not going to figure out gaming with what you have, but is this really the priority?"

Kotick is right on several points. He's right that Microsoft lacks the creative DNA to properly run an adaptive videogame business where software innovation and not business model innovation is concerned. Just this morning I received a press release about Xbox's new generative AI model for gameplay, dubbed Muse. Interesting stuff, sure, but it's not a game. Xbox, for two console generations now, has been incapable of competing with the competition when it comes to developing and releasing first-party software at a rate that can satisfy Xbox users. Perhaps because, as Kotick said, the company lacks creative DNA, in the sense that it doesn't know how to manage development studios.

It's an interesting observation from Kotick, especially in early 2025 when it's looking more and more likely that Microsoft's gaming interests will downgrade to the status of publisher rather than platform holder. Xbox head Phil Spencer has been preparing Xbox diehards for this for months: Xbox games will ship on PlayStation and Nintendo as a matter of course.

The other part of Kotick's answer to Nadella is equally important: "is this really the priority?". Microsoft probably doesn't need to be in gaming, despite the Xbox Series X generation making the company over $80 billion. But with Microsoft's assets, it doesn't make sense for it not to be in gaming. Microsoft has so many clear advantages – a huge IP portfolio, Windows and its install base, familiarity with hardware manufacturing – that it continues to be bizarre that it is so on the backfoot.

Whatever the case, it's clear that Microsoft's sheer size isn't doing it any favours. Creative companies need to be adaptable and fleetfooted. Microsoft, surely, is not. ■

Shaun Prescott is an Australian editor for PC Gamer, GamesRadar and PLAY, and writes for APC, TechRadar and more.

AI has entered the game

Nvidia RTX 50-series pushes AI to the forefront.

Two years on from the launch of the RTX 4090, Nvidia officially announced its Blackwell RTX 50-series GPUs, with availability starting January 30. Several of the models offer relatively incremental upgrades over the existing 40-series cards, but the top-end RTX 5090 will provide a big boost to gaming performance, and perhaps a bigger boost to AI workloads.

The GB202 chip at the heart of the 5090 comes with 170 streaming multiprocessors, 21,720 CUDA cores, and 32GB of GDDR7 on a 512-bit memory interface – clocked at 28 Gbps. That's 1.8TB/s of memory bandwidth, about 80 percent more than the prior generation RTX 4090, 27 percent more raw compute, and 33 percent more VRAM capacity. But while the improvement in like-for-like compute may not be that significant, Blackwell also adds native support for FP4 to the tensor cores, running twice as fast as Ada's FP8 code. That gives the 5090 up to 3.4 PetaFLOPS of FP4 throughput, which Nvidia classifies as 'TOPS' (teraOPS).

Similar to the 40-series, the 50-series will depend on new features to distance itself from the previous-generation GPUs. Nvidia showed performance where the 5090 was over twice as fast as the 4090. However, the 5090 was using Multi Frame Generation (MFG), a new technology that leverages Blackwell's FP4 compute.

MFG uses Nvidia's tensor cores and runs faster than the Optical Flow Accelerator used for framegen in the 40-series. Because it's software-based, that makes it easier for Nvidia to enhance and improve the functionality. Instead of generating a single frame with AI, it can generate up to three in between previously rendered frames. That's potentially a 4X improvement in 'frame rate' – it's in quotes because these generated frames don't use new user input.

I asked Nvidia CEO Jensen Huang about DLSS 4 MFG, and he made a rather bold claim, saying DLSS 4 "predicts the future rather than interpolating the past." That turned out to be incorrect, as it's still using interpolation. But it got me thinking: was Jensen incorrect, or already talking about the future?

DLSS 4 uses interpolation for MFG, but will we get DLSS 5 with frame projection? That seems to be where Nvidia is heading, given what we heard about Reflex 2.

Reflex 2 predicts where the camera will be before rendering, and then, just before sending the rendered image to the monitor, it samples user input and warps the camera position. Certain parts of the screen that were previously occluded could become visible. In a demo, Nvidia showed these as white pixels. A trained AI in-painting algorithm runs to fix the missing pixels. If Nvidia can already do this with Reflex 2, how close is it to projecting one or even multiple frames ahead?

There will, of course, be rendering errors with projection. But when the frame rate is high enough, the occasional artifact doesn't stay on screen long enough to detract from the gaming experience.

How does MFG running on the RTX 50-series feel? With a 240Hz 4K display using upscaling and MFG running on an RTX 5090, it was smooth. But I wonder how that will translate down to the eventual RTX 5060 level of hardware. I suspect you'll want the base to be 40fps or higher to get a good experience, which means generated fps of 160 or more – which will still feel like 40fps, even if it looks like 160. ■

"DLSS 4 uses interpolation for MFG, but will we get DLSS 5 with frame projection? That seems to be where Nvidia is heading, given what we heard about Reflex 2."

Jarred Walton has been a PC and gaming enthusiast for over 30 years.

AMD's pricing challenge

Fun and graphics card games at CES 2025.

As the old saying goes, AMD never misses an opportunity to miss an opportunity. So it was at CES 2025 in Las Vegas. We were all expecting AMD to go big with the new RDNA 4 GPUs during its CES keynote. In the end, RDNA 4 was barely mentioned.

There were more details on RDNA 4 in the pre-release materials handed to journalists prior to the keynote than in the actual keynote. AMD reps claimed the sparsity of info was due to time constraints. The organisers of CES, we were told, only allow for 45 minutes for such talks. AMD had a lot to announce, and RDNA 4 needed more than five minutes shoehorned into a broader presentation.

Personally, I don't buy that. In the pre-release slides given to journalists, AMD named the first two RDNA 4 cards as the Radeon RX 9070 and 9070 XT – again, just as expected, slating them for a launch in the first quarter of 2025. That means they'll be out by the end of March at the latest, which in turn means they're imminent. So imminent, I can't believe AMD didn't plan to go into more detail with RDNA 4 at CES.

So, what happened? In a word, Nvidia. Okay, AMD's keynote came before Nvidia's, but it's a small world, and I suspect AMD got wind of some of the details of Jensen Huang's upcoming keynote. I think AMD found out about the pricing of Nvidia's new GPUs, and it wasn't what they were expecting.

Leading up to CES, all the noise involved very big-dollar figures attached to Nvidia's new RTX 50 graphics cards. As it turned out, the new RTX 5090 is pretty expensive. The rest? Not so much. So I suspect that AMD decided to take a little time to decide how to react. After all, AMD is already on record as characterising RDNA 4 as being about value for money. With RDNA 4, AMD is not going after the very high end; it's aiming for maximum bang for your buck in the mid-range and below.

Another of those pre-keynote slides from AMD showed that the new 9070 XT is aimed at existing Nvidia GPUs up to and including the RTX 4070 Ti. The slide didn't clarify if that positioning was predominantly price or performance related, but taking everything we know into account, the pricing of the new RTX 5070, and perhaps to some extent the 5070 Ti, are critical to the value proposition of AMD's new GPUs.

My hunch is that AMD had planned to announce the new RDNA 4 cards in more detail, including pricing. But then, the RTX 5070 suddenly made their planned price points for the new RX 9070 and 9070 XT look less appealing than intended.

AMD could, of course, have made an adjustment, but perhaps it preferred to take a little time to be sure about Nvidia's pricing, and also to get a better feel for exactly how their new cards compared in terms of performance.

In that sense, my 'missed opportunity' quip was unfair. I think AMD probably made the right call this time. RDNA 4 is absolutely going to trade on value, so pricing is critical. It made the mistake of positioning cards like the RX 7800 XT too high at launch, only to see real-world prices tumble. Avoiding a repeat of that mess with RDNA 4 is surely critical. ■

RADEON
TUF GAMING

AMD needs to get the pricing of its new RDNA 4 GPUs just right.

© Intel

Six raw 4K panels for breakfast, laced with extract of x86... Jeremy Laird eats and breathes PC technology.

The age of doubt

It's time for a zero-trust approach to "news", argues the very real Jon Honeyball.

It was a watershed moment. I'm not too sure what brought it on – maybe the rather nice gin and tonic I was enjoying in Virgin Upper Class on my flight to Los Angeles en route to CES? But I've drunk many gin and tonics and they've never had this effect before. But there, undeniably, it was. As real as the bubbles surrounding the slice of lemon, the realisation that I couldn't trust most anything on the internet anymore.

It's not just the rise of AI generated audio and video, where the creation of a deepfake is a few mouse clicks away: it's the underlying worry that most anything generated by a GPT-style LLM is another layer of obfuscation and fog. I know some will give links through to the underlying site from where a particular "fact" was scraped, but when I visit those sites I often conclude that the words were concocted in another AI engine.

That video you have just watched? It might have looked authentic, but Hollywood-grade imaging is now available on your phone, let alone your desktop. The fakery goes deeper and deeper, and at some point we have to say "stop!"

I won't engage with AI generated content, simply because it's a rising level of noise that my head can't cope with. The issue is not whether AI generated content is good or not – it's that there is already too much of it, and it will only get worse.

AI isn't the only problem: my trust in so-called news has also evaporated. Now anyone with a smartphone can be a social newscaster; the previous true professionalism, where cost and effort has gone into training journalists, has been replace by the faux professionalism of a slickly made video that anyone can create. And that video can circle the world via social media quicker than you can say "tap to view", whether it's real or not.

Meanwhile, platforms are claiming that they are the one true source, that they are "open" and support "free speech" whilst simultaneously shutting down editorial management, unhindered by any semblance of responsibility for the content on their site. Do you really have the time, energy and emotional strength to get involved in a "discussion" on Twitter, when you consider the pile-on that can happen from those who are sure you are wrong? It's school-yard bullying taken to a global scale.

So what is the answer, other than to retreat into our caves to hide away from noise? Simple: find outlets where the journalist puts their name, face and preferably an email address to their words. Get to know what they think and why. Most everyone has biases and some form of an agenda, but that's true everything. Get over it. We need to relearn how to listen to conversations, to interact without erupting in a blaze of anger.

Is the mainstream media always right? Of course not. But it is time to assume that everything else is rubbish, without value, unless you have reason to assess otherwise. Give upticks for the genuine people who put in effort, and actively shun the rest. The noise simply isn't worth the effort. ■

"Now anyone with a smartphone can be a social newscaster; the previous true professionalism, where cost and effort has gone into training journalists, has been replace by the faux professionalism of a slickly made video that anyone can create."

Jon Honeyball is certified 100% real.

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Live in the future now

You can have a driverless car, metaverse workplace and home-cleaning robots today! But it will cost you and likely disappoint, says Nicole Kobie.

The future is unevenly distributed. That famous axiom, courtesy of sci-fi author William Gibson, has become a tech cliché, but when it comes to the arrival of futuristic technologies it holds true. Yes, many sci-fi innovations are already here if you're willing to put in some effort and turn on your imagination, but you must also lower your expectations.

Consider driverless cars, AI personal assistants and robot butlers. These technologies loom over the horizon. They may never come to be, perhaps tripped up by technical limitations or regulatory demands. But you can try out the early versions of these ideas now for a small taste of what the future could bring.

Here's how to capture a glimpse of the future by renting a swish car, automating your work with AI, upgrading your Zoom calls, working less, and spending far too much money on home appliances.

Hit the road in a driverless car

Dream of sitting back and letting the car do the driving? Australia lags behind our US and UK friends, with over 700 laws in place preventing the use of fully autonomous cars here. But there are a few ways you can achieve this now. The first is to book an Uber and pretend the driver isn't there – but don't do this. It's rude and it will likely hurt your rider rating. No-one wants to slip below four stars, after all.

The second route is to head to the US or China for a holiday. Pick a destination such as San Francisco or Beijing that has robotaxis operating, download the requisite app, and enjoy geographical and temporal tourism at the same time.

For a ride in a Waymo, you can also head to Los Angeles or Phoenix, and the company plans to expand to Austin, Atlanta and Miami next. Rides are limited to specific catchment areas, however, so you'll have to plan your trip carefully.

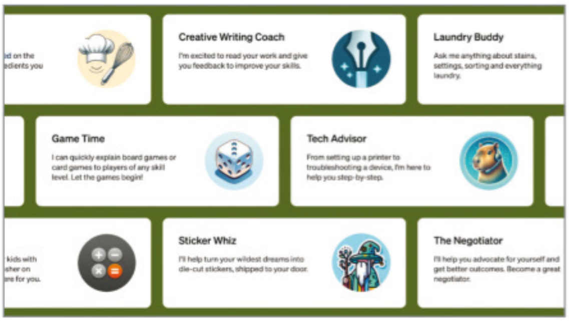
Not keen on spending time in the US? You can visit the future of driving while in the UK. Level 2 driverless cars are approved on British motorways, so buy or rent the right vehicle and you too can feel the thrill of the future of automotive automation: carefully changing lanes, maintaining a safe distance from the car ahead and dutifully obeying speed limits.

So far, just one driverless system has been approved: Ford's BlueCruise, which is available on the Mustang Mach-E. If you're purchasing the electric version of the classic Ford car, it comes with BlueCruise free for 90 days, and then costs $49 a month – that's right, the future comes with a subscription. Alternatively, hire a Mustang; Hertz offers the vehicle with BlueCruise enabled.

But manage your expectations. BlueCruise only works on motorways, and the driver must be watching the road at all times, though their hands can be removed from the steering wheel. Indeed, that's the main way that driverless differs from other advanced safety systems in newer cars, which can also watch for lane markings,

ABOVE Waymo's driverless taxis can be hailed in LA and Phoenix, Arizona.

BELOW AI is fast becoming capable of becoming your personal assistant.



d on the
edients you

Creative Writing Coach
I'm excited to read your work and give you feedback to improve your skills.

Laundry Buddy
Ask me anything about stains, settings, sorting and everything laundry.

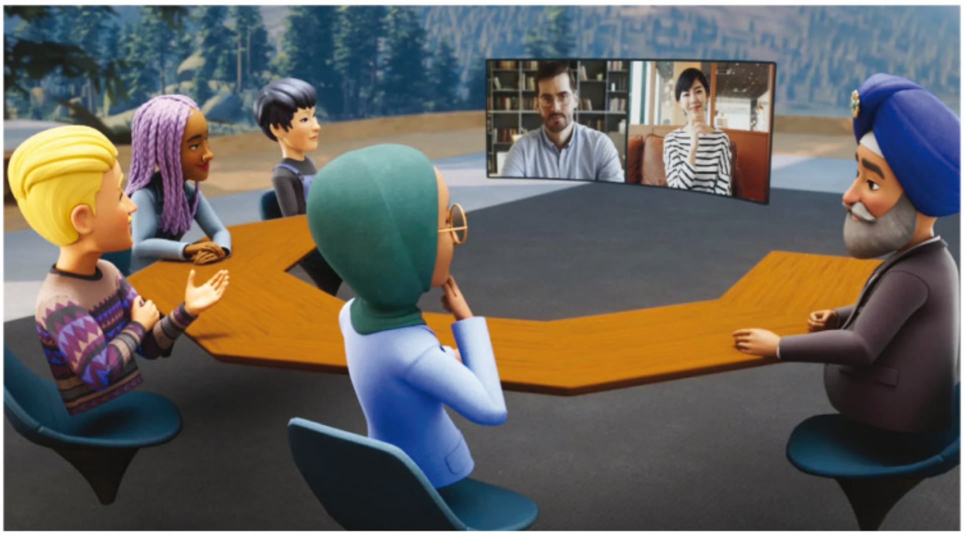
Game Time
I can quickly explain board games or card games to players of any skill level. Let the games begin!

Tech Advisor
From setting up a printer to troubleshooting a device, I'm here to help you step-by-step.

kids with
sher on
re for you.

Sticker Whiz
I'll help turn your wildest dreams into die-cut stickers, shipped to your door.

The Negotiator
I'll help you advocate for yourself and get better outcomes. Become a great negotiator.



brake in an emergency and feature adaptive cruise control.

Indeed, the only appreciable differences between driverless level 2 cars and existing automation-based safety features are the technologies that power the systems (computer vision versus machine learning) and the fact that you can move your hands away from the wheel using BlueCruise. That's right: the future is your hands resting aimlessly.

Automated assistant

Imagine the luxury of a personal assistant: paying your bills, managing your admin, ending your subscriptions to services you haven't used in years. AI is approaching some utility on this front, although what it can actually achieve remains limited.

To get started, simply open ChatGPT or your alternative generative AI machine of choice, and use it to fetch answers or explain how to do something. Once you've got to grips with how the system works – and doesn't work – it's time to build what's known as a Custom GPT.

For this, you'll need ChatGPT Plus, which is a more fully featured version of the chatbot that requires a paid-for subscription at $20 a month – did we mention that the future comes with a monthly cost? After you've handed over your credit card details, you can either build your own chatbot or head to the GPT store to install one made by another user.

If making your own, ChatGPT will run you through a few setup questions to personalise the assistant. This will be remembered every time you use the assistant, saving you from needing to give the system context or background or instructions with each use.

What could it do? Teach you a skill, act as a personal trainer reminding of exercises, or even help with work tasks. Want to be better organised when working from home? Create a Custom GPT to prioritise tasks, nag when something is late and remind you of meetings. You'll still have to update it each morning with your day's work, but you can offload the thinking to the Custom GPT.

Now, if you'd rather not pay, head to You.com, which uses a range of AI models including OpenAI's GPT-4o. It provides a range of prebuilt assistants to help create Python functions, pull together sales emails, and target content with SEO keywords. It may not be the smart virtual assistant you've always dreamed of, but for some tasks writing a prompt is still better than doing all the work yourself.

Virtual work

Tired of boring old Zoom calls when you're working from home? Forget looking into a webcam when you can immerse yourself in the metaverse for a quick all-hands catch up. Zip into the future with virtual reality.

First, you'll need a VR headset such as the Meta Quest 3S. Then you can use Meta Horizon Workrooms, which is Meta's metaverse meeting room, where your avatar can sit around a virtual desk alongside the avatars of your coworkers. Those who have VR headsets, at least.

Those who don't can still join the meeting, but will show up in a virtual screen in the Workroom; in other words, avatars will sit around a digital table, watching your face talking via Zoom, thanks to integration with that company. Yes, this is weirder than a regular video call, and may just make you long for a full return to the office. Still, at least it's easier than booking a meeting room in real life.

Mootup is an alternative virtual workspace that lets you hold meetings in a shared digital environment without the need for a headset, but you will have to navigate designing your own avatar. Mootup has a wonderfully wide range of inclusive settings, from prosthetic legs to headscarves, but if you're using this for professional purposes perhaps suggest some office-friendly design guidelines so you can recognise the digital representations of your colleagues. Given there's no way to expand the waistline of the avatar, though, these virtual versions of ourselves are all a bit inaccurate anyway.

Work less now

The future of work is three-day weekends. Four-day work weeks are on the rise. Admittedly, there's been pushback from companies and tech bro CEOs like Elon Musk, but Japan is rolling back weekly

TOP Meta Horizon Workrooms lets you sit around a virtual table
BELOW Ecovacs' Winbot W2 will clean your windows for you

LEFT The Ecovacs Airbot Z1 roams your house to purify the air

3 humanoid robots coming soon(ish)

Robot butlers are probably still decades away, but humanoid robots are becoming a reality. One, Digit, is already working in a US factory, while the rapid maturing of AI means cutting-edge robots can chat with you and process their surroundings. Here are three coming soon.

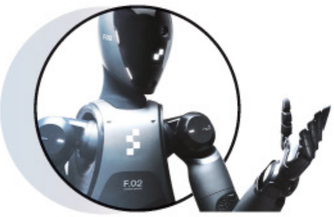


FIGURE 02

Don't expect this stylish 5ft 6in robot to run towards you – think Julie Walters' shuffling waitress – but it can hold a conversation thanks to ChatGPT and recognise objects, and its fingers have a huge range of movement. Sadly we don't yet have a price or a likely release date, although BMW has tested it in a manufacturing plant.

AMECA

Head to engineeredarts.com and you can order an Ameca today. Or you can rent one – the price depends on what features you want. The current version can't walk, but with AI on board it can chat to people, so could be a superb addition to an exhibition space. Especially as its advanced facial features can express a range of emotions.

OPTIMUS GEN 2

Even after you remove the Musk hype filter, the 5ft 8in Optimus Gen 2 should set any futurist's pulse aflutter. It seems to have it all: full mobility, advanced AI, dextrous fingers and the sheer robotics and AI knowledge of Tesla. It's expected to cost between $30,000 and $40,000 on its release, supposedly in 2026.

hours in the hopes of improving falling reproductive rates – take the day off and have some fun of a very specific sort!

In Australia, workers have the legal right to request flexible working, and that can include reduced or compressed hours. That doesn't mean your boss must approve your futuristic working plan, but at least you can ask.

If management isn't keen on fewer hours for the same pay, perhaps ask if it's possible to reduce your salary or work more hours on the other four days – taking a shorter lunch or working later in the evening could give you a day off every fortnight, for example.

And if that doesn't work, make your own four-day working week for a taste of the future by simply booking every Friday off for a month. It's nice, isn't it?

Managers, if you want to be particularly forward looking, consider running a four-day-work-week trial.

Robot butlers

Tesla's Optimus humanoid robots will be available in 2026 for between $30,000 and $40,000 – of course, Elon Musk also said he'd be on Mars by now, so temper your expectations. In the meantime, simply fill your home with automation and much smaller robotics, some of which are actually useful.

First, if you haven't already done so, set up some home automation – flipping switches and setting thermostat temperatures is so last decade. Install a Nest thermostat for heating, Philips Hue or LIFX smart bulbs for smart lighting, and a Ring or Arlo doorbell rather than peek through your front-door. If you can't be bothered to open your app for controls, hook them up to Alexa or similar. That's hardly the future, but it's a good starting point.

Next, it's time to automate your cleaning with a Roomba-style vacuum and mop robot. Similar robots are available to clean windows (Ecovacs Winbot W2) and gutters or even mow the lawn. The Ecovacs Airbot Z1 will roam your house to purify the air, the SmartDuvet will make the bed for you (sort of), and the Townew bin will tie up the bag for you and put a fresh one in its place, though you'll still have to haul the full bag to the bins outside yourself. And the UBPet C20 is a self-cleaning litter tray with an app so you'll never have to acknowledge your cat's output again.

Owning all of these will come at a cost of a couple thousand dollars, plus you'll need to find space to store and charge each device. It may be cheaper and simpler to find a human cleaner and hand them a mop and bucket, but if there's a task you particularly hate doing, it's worth trying to automate it.

Of course, none of those devices looks anything like Tesla's Optimus or the Jetsons' Rosey. If you're hoping for a humanoid helper, you'll need to think a bit smaller.

Amazon abounds with toy robots that are programmable, notably the Lego Mindstorms kits and humanoid designs such as the UBTECH Alpha Mini. The EBO X is a wee robot that rolls around your house looking for burglars while offering conversation via GPT-4o mini or playing music – think of it as an Amazon Alexa on wheels with a digital face. And if that's not a terrifying vision of the future, we don't know what is.

Live in the future, now

Driverless cars, AI assistants, metaverse meetings, robot cleaners – the future is already here, and not only is it unevenly distributed, it's not very useful, either. Trying out these technologies may reveal the current and future limitations of some of these ideas, as much as we'd love an AI that could do our admin for us (come on OpenAI, make it happen).

For now – and, possibly, for the foreseeable future – if you don't want to drive a car, then call a cab or wait for the bus. Need an assistant? Hire a virtual human online, or learn to delegate. Tired of Zoom meetings? Call your colleague and go for a walk while having your chat – or better yet, go to the office now and then (but only when you want to). Too tired to clean? Pay a person to do it; they'll do a better job than a robot.

There is one future idea that's easy to welcome, however: working less. After all, that's what technology should have been helping us do all along, rather than extending our working hours as we check emails after the kids are in bed or dip into Slack on our commute into the office. Whether powered by AI or merely by social pressures, if we do get shorter working weeks, at least we'll have more time to do our chores while we await the arrival of personal AI admin assistants and robot butlers. ■

PC GAMER

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Over **22 million** gamers visit us online every month.

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Asus offers several Nvidia 50-series cards with a range of performance and features to suit casual gamers through to tweaking enthusiasts.

RIGHT: Asus quality and engineering comes together across the entire 50-series range, which includes a stunning water cooled Astral 5090 model!

THERE'S AN ASUS 50-SERIES GRAPHICS CARD FOR EVERY KIND OF GAMER, INCLUDING YOU!

THE ASUS FAMILY OF EXTREME GRAPHICS POWER

The long-awaited new Nvidia RTX 50 series graphics cards are upon us, and Asus has applied its considerable engineering expertise to ensure that they offer the maximum amount of power, performance, reliability, stability, efficiency and value to buyers. The improvements are so significant, in fact, that the top models form part of a brand-new ROG range called 'Astral.' What's more, Asus has innovated further by developing new GPU-first power supplies to go with the new cards. Here's what's arriving...

ASUS' NEW GRAPHICS CARD RANGE

Asus is very experienced when it comes to delivering the latest and greatest graphics cards, and so it's developed variants for all types of buyer. There are several models which range from those suited to users that simply want a wallet-friendly, high-performing graphics card, to the ultra-enthusiast buyers who want to achieve ultimate performance... and options for all those who lie in between.

INTRODUCING ROG ASTRAL

It doesn't take long to see why Asus associated its new top-tier graphics cards with the stars. The ROG Astral GeForce RTX 5090 OC Edition 32GB GDDR7 and its RTX 5080 counterpart is extra special, so let's delve deeper to see how Asus has augmented it to maximise its potential.

The first thing to note is that its monstrous performance comes in part thanks to the extreme cooling engineering that's gone into this card. The combined effect of a massive heatsink powered by vapour chamber designed with milled pathways, and precision-engineered optimised fin array provides a 10 percent improvement in thermal performance over its top-tier predecessors.

For the first time, there's a four-fan (Axial-tech) array that boosts air flow and pressure by up to 20 percent. A bespoke vapour chamber is finely polished to maximise contact to further-decrease GPU temperatures by up to 2^{C}. This is assisted by a phase-change GPU thermal pad to ensure optimal heat transfer away from the chip.

It's robust too. An enhanced 'GPU Guard' mounting bracket means all four corners of the GPU are securely fastened which also prevents bending. The full metal diecast shroud, backplate and rear I/O bracket further brace

ROG ASTRAL
GEFORCE RTX 5080
PRIME
OC 16GB
GEFORCE RTX 5080
TUF GAMING GRAPHICS CARD
GEFORCE RTX 5090
ROG ASTRAL
GEFORCE RTX 5090

Pair your new Asus 50-series graphics card with the all-new ROG Thor III PSU for outstanding stability and reliability.

the PCB for rigidity. There's a protective PCB coating that fends-off moisture, dust and extreme temperatures. Asus' bespoke, 'Auto-Extreme' manufacturing process (which uses efficient, one-pass soldering techniques and fewer chemicals) stresses components less and further facilitates flawless fabrication. All this combines to maximise both performance and stability.

TWEAKER'S PARADISE

Overclocking types and demanding gamers will appreciate the powerful 80-amp driver MOSFETs on the RTX 5090 variant, which provide a generous 35 per cent more headroom for performance pushing. There are also two additional fan headers to sync with case fans and a dual BIOS feature that switches between Performance and Quiet (2.95x quieter) modes for when you need to stop drawing attention to your computer.

The Astral range also comes with GPU Tweak III software which communicates with numerous sensors embedded in the VRMs, chokes and VRAM to provide a thermal map from within the card to tightly target performance adjustments. It contains a Power Detector+ app which works hand-to-hand with proprietary circuitry that monitors power draw over any of the six power pins on the power cable and warns the user of any issues in real time safeguarding your investment. It also has a 'Mileage' feature to track usage at different power levels plus all the OC tools and tweaks including the fully automated OC Scanner, exactly as you'd expect for such premium cards.

On top of all that, Asus includes its MuseTree Generative AI app to create amazing imagery locally and easily. Plus, if the above is not enough, there's also a month's free subscription to the (always useful) Adobe Creative Cloud.

A CARD FOR EVERY GAMER

Of course, not everyone wants or needs such extravagant performance potential just like not everyone wants to drive to the shops in a car set-up for a racetrack.

For the average enthusiast, there's the ROG Astral LC RTX 5090 card. This only takes up 2.5 slots in a case, thanks to a more space-efficient cooling shroud and the switching-in of liquid cooling technologies. It still has three, Axial-tech fans and a hefty extra-thick 360x38 radiator and Full-Covered Cold Plate, but, other than that, it generally matches the top-tier Astral for specs and features.

Next up are Asus' TUF Gaming cards which are available in Nvidia RTX 5080 and 5090 flavours. These beefy, 3.6-slot cards retain the phase-change thermal pads and protective PCB coating of the Astral line, but utilise up to 12-heatpipe (plus vapour chamber) cooling technology instead. The change in cooling tech brings with it Military-Grade robustness for reliability. The extensive, expert OC monitoring tools and features are dialled-down but this remains a premium graphics card that will save you some bucks.

Finally, there's the Asus Prime RTX 5080. The friendly 2.5-slot SFF SKU is designed to suit environments where real estate is a concern. There's still plenty packed in – including the dual BIOS and advanced engineered cooler.

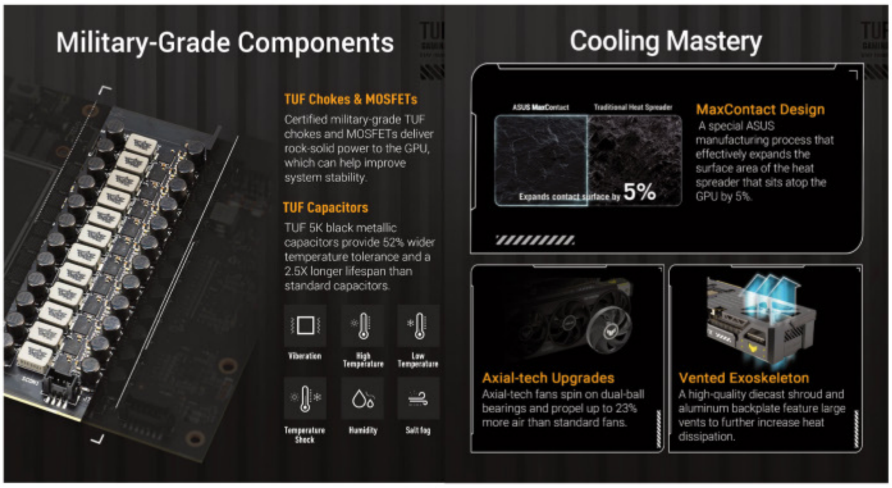
NEXT GEN POWER SUPPLY

With great power comes great responsibility. For reliable power delivery Asus has PSUs to provide the perfect power-efficient platform for its graphics cards. These new voltage-sensing 'GPU-first' power supplies are part of the new ROG Thor III, ROG Strix Platinum and TUF Gaming Gold series PSUs. The GPU-first design enhances voltage stability by up to 45 per cent no matter how power-hungry your gaming or overclocking needs might be. There's also an integrated GaN (Gallium Nitride) MOSFET (in addition to traditional silicon equivalents) to further enhance stability and performance. It all means that, whether you're starting-off with a very heavy load, or performing tasks with widely varying voltage changes, the enhanced stability regulates the power draw to fend-off troublesome power fluctuations.

PERFORMANCE FOR ALL

So, whatever your budget, Asus has you covered with its Astral, ROG, TUF, Strix and Prime ranges of power supplies and graphics cards.

Find out more about how you can achieve an incredible gaming experience at **www.asus.com/microsite/Graphics-Cards/GeForce-RTX-50-Series**


Military-Grade Components

TUF Chokes & MOSFETs

Certified military-grade TUF chokes and MOSFETs deliver rock-solid power to the GPU, which can help improve system stability.

TUF Capacitors

TUF 5K black metallic capacitors provide 52% wider temperature tolerance and a 2.5X longer lifespan than standard capacitors.

Cooling Mastery

MaxContact Design

A special ASUS manufacturing process that effectively expands the surface area of the heat spreader that sits atop the GPU by 5%.

Axial-tech Upgrades

Axial-tech fans spin on dual-ball bearings and propel up to 23% more air than standard fans.

Vented Exoskeleton

A high-quality diecast shroud and aluminum backplate feature large vents to further increase heat dissipation.

Find the best deals
on new gear at
getprice.com/au

The A-List

The best products on the market, as picked by our editors.

Premium laptops

Apple MacBook Pro M4

ONE OF THE BEST LAPTOPS THAT'S EVER BEEN MADE.

This M4 update to the already brilliant MacBook Pro line is an easy recommendation, so the big question becomes do you choose the 14in version or 16in. But whatever you choose should last for years, and look great while it's doing it.

From $2,499, apple.com/au

THE ALTERNATIVES

ASUS ZENBOOK DUO
A dual-screen laptop that uses a practical layout and excels at everyday use. The unique form factor is incredibly handy for those who need dual screens on the go.
$3,999, asus.com

APPLE MACBOOK AIR
The MacBook Air M3 replaces the M2 model previously listed here. It's a powerful and quiet ultraportable with an unbeatable battery life and screen.
From $2,099 apple.com/au

MICROSOFT SURFACE LAPTOP 7
A shining example of just how good a Windows laptop can be. Despite a few minor drawbacks, the Surface Laptop is a fantastic package that offers performance and battery life.
$1,899, microsoft.com

Business laptops

HP OmniBook X

THE QUALCOMM CPU REALLY DELIVERS.

The latest Qualcomm CPU helps create a standout laptop that will impress compared to Intel powered alternatives. The OmniBook X has been on sale across all major retailers for $2,079. At this sort of price the X is the cheapest Snapdragon X Elite laptop going, and a compelling buy.

From $2,079, hp.com

THE ALTERNATIVES

DELL LATITUDE 7340
This 1.1kg laptop offers terrific battery life and, if you choose the better non-touchscreen (look for 400 nits of brightness in the specs).
$2,475 lenovo.com/au

ASUS ZENBOOK S 16
The Asus Zenbook S 16 offers premium performance in the ultraportable category and competes well with alternatives such as the Surface Laptop 7 or Macbook Pro.
$3,499, asus.com.au

LENOVO YOGA 7I AURA
The Lenovo Yoga Slim 7i Aura is a sleek, versatile laptop with a great display, excellent build quality, and solid performance, and is an especially good buy when on sale.
$2,799, lenovo.com /au

Gaming laptops

Alienware m16 R2

A PREMIUM AND AFFORDABLE GAMING & WORK MACHINE.

There are cheaper gaming laptops, and faster ones too, but we love the balance offered by the m16 R2. Who doesn't want a big 16in gaming laptop, featuring a Ultra 9 CPU, a RTX 4070 GPU and 32GB of RAM? And for a decent price, considering it's from Alienware.

$3,300, dell.com

THE ALTERNATIVES

LENOVO LEGION 5I
Best in class performance from the powerful RTX 4070 GPU and stand out features such as 140W PD charging.
$3,499 lenovo.com/au

ACER NITRO V 16
It's a cheap and cheerful gaming laptop, but that's exactly what the Nitro V series does best, and overall this new 16in model offers great bang for buck.
$1,500 store.acer.com

NEW **MSI TITAN 18 HX A14V**
A wallet-busting powerhouse that pushes the limits of gaming laptops. The MSI Titan 18 HX offers unmatched power and luxury.
$8,599 au.msi.com

Everyday laptops

Asus Zenbook S 13 OLED

ASUS AND INTEL TEAMED UP TO BUILD A MACBOOK AIR KILLER.

ASUS Zenbook S

A compact and budget friendly Ultrabook that's the best available device for many on-the-go professionals. Compared to the MacBook Air 13, it has an additional HDMI and USB-A port, an SSD that's roughly twice as fast, and the screen is brighter and offers rich OLED contrast.

$2,099, asus.com

THE ALTERNATIVES

ACER SWIFT 14 AI (INTEL)
The Acer Swift AI 14 is a great overall package, and while the $2,399 RRP feels steep, we've seen it discounted to $1,800, making it an excellent buy.
$2,399 acer.com

APPLE MACBOOK AIR 15
An awesome plus-size MacBook Air with great battery life and graphical performance. GPU performance and battery life are the standout perks here. **From $2,199 apple.com/au**

LENOVO YOGA SLIM 7X
This is almost everything we could want in a Windows laptop, and offers a compelling mix of features, strong performance and amazing battery life.
$2,909, lenovo.com

Chromebooks

NEW

Asus Chromebook Plus CX34

A sleek and relatively affordable ChromeOS workhorse, the Asus Chromebook Plus CX34 delivers strong performance and features at a competitive price when on sale, and is ideal for budget-conscious users.
$699, asus.com

Lenovo Flex 3i Chromebook

This isn't the most powerful Chromebook, but students need reliability more than power – especially if they're only really using it for homework, note-taking, and perhaps the occasional bit of Netflix.
$367, lenovo.com/au

Lenovo IdeaPad Duet

The Chromebook answer to Microsoft's Surface tablets, this is a seriously versatile device – albeit not the speediest (although we never found it to be painfully slow while carrying out everyday tasks). For this price, and with a 16hrs 14mins battery life, the Duet is a great choice.
$297, lenovo.com/au

Tablets

Apple iPad Air (M2)

We love the new iPad Pro, but for most people the M2 iPad Air is not only far better value but also all the tablet they'll need. It supports the Magic Keyboard and Pencil Pro, plus it's now available in both 11in and 13in sizes.
From $1,299, apple.com/au

Apple iPad Pro (M4)

The best tablet in the world becomes even better thanks to Apple's stunning M4 chip, a gorgeous OLED screen and the must-have accessory: the all-new Pencil Pro. But it comes with an obvious downside of cost, with the cheapest 13in incarnation costing $2,199.
From $2,199, apple.com.au

Samsung Galaxy Tab S9 Ultra

This 14.5in tablet offers a size and versatility that even the iPad Pro can't match, with its high price more than justified by the quality of Samsung's AMOLED panel, speakers and productivity software.
$1,999, samsung.com

Everyday monitors

Asus ROG Swift OLED PG32UCDP

We've seen several ultimate gaming monitors in recent months but, from the specs alone, Asus might just have made the most *ultimatest*: 480Hz refresh rate, matte-screen HDR OLED, 32-inch 4K.
$2,399, asus.com.au

BenQ BL2790QT

A 27in, 1440p monitor that's packed with quality, from its brilliant OSD to several clever features designed to fight eye fatigue. Text and images look sharp and punchy, its USB-C docking capability is always welcome, and the speakers are surprisingly decent.
$459, benq.com

LG UltraGear 32

The new LG UltraGear 32GS95UE-B. AAU is not perfect. But it does a pretty comprehensive job of blowing every existing 32-inch 4K gaming monitor based on Samsung's QD-OLED panel tech into last year.
$2,399, msi.com

Professional monitors

Eizo FlexScan EV3240X

With images that whack you between the eyes as soon as you lift it, fully assembled, from its box, this 32in 4K monitor is our top choice pick for anyone willing to make such a hefty long-term investment.
$2,696, eizoglobal.com

Eizo ColorEdge CG2700X

A brilliant choice for professional designers, whether working solo or in teams, thanks to its dedication to providing accurate colours across potentially years of life. It's also bang up to date for connectivity, with USB-C and RJ45 making it easy to manage.
$5,500, eizoglobal.com

Asus ProArt Display PA278CFRV

While it costs too much for casual users, workers and gamers, for professional designers, it's an attractive proposition with easy-to-access, designer-friendly tools and presets.
$629, **asus.com**

Home office printers

NEW

HP OfficeJet Pro 9130e

This versatile inkjet all-in-one – which includes a 35-page ADF – pumps out high-quality prints at laser-rivalling speeds. Likewise scans and copies. Print costs are reasonable, too.
$248, hp.com

NEW

Canon i-Sensys LBP243dw

Everything you could want from a mono laser printer – it doesn't come with a scanner – the LBP243dw produces excellent results at speed. You also get Wi-Fi and wired networking.
$479, canon.com

Brother MFC-J4540DW

Home workers will love this inkjet all-in-one. It combines an incredible range of features with all the connectivity you need and extreme ease of use. Output quality is fine, it offers the best cloud support around and the high-capacity ink pack could keep you going for years.
$329, brother.com

Find the best deals
on new gear at
getprice.com/au

Wireless routers

NEW Asus RT-BE92U

A premium, consumer-grade Wi-Fi 7 that doesn't cost the Earth. The Asus RT-BE92U doesn't put a foot wrong. It's fast, feature-packed and it even looks good too. At $424 it's also excellent value and is our new Editor's Choice.
$424, rog.asus.com/au

Synology WRX560

Its quad-band Wi-Fi smashed-through our performance tests managing 791.5Mbps up close, 375Mbps two rooms away and an amazing 216.7Mbps down the garden..
$419, synology.com/au

Netgear Nighthawk RS700S

Make no mistake – you won't get stunning speeds out of this Wi-Fi 7 router today. But if you must buy a router now and want future-proofing, this is a solid choice. But honestly, we would recommend that you wait.
$1,499, netgear.com

Mesh Wi-fi

TP-Link Deco XE200

There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack should be enough for most premises.
$1,299 (2-pack), tp-ink.com

TP-Link Deco X20

The Deco X20 makes it possible to upgrade your home network to Wi-Fi 6 for the price of some standalone routers. The HomeCare functions are also a great bonus for households where lots of devices are fighting over the bandwidth. **$227 (2-pack), tp-link.com**

Asus ZenWiFi AX

The interface and design certainly aren't the prettiest (the charcoal version is straight out of the 1980s), but if you're after strong performance, great features and plenty of expansion potential, the ZenWiFi AX is a compelling prospect.
$939 (2-pack), asus.com/au

NAS servers

Asustor Nimbustor 4 Gen2 AS5404T

A particularly strong choice as a media server, the updated Nimbustor 4 is both flexible and quick. Asustor's Nimbustor 4 AS5404T is a four-drive NAS enclosure aimed at demanding home users or small offices.
$889, asustor.com

QNAP TS-264

The TS-264 combines strong specifications and performance for a reasonable price. We wouldn't choose this NAS as a starting point for a small business, but it is a good choice as a home NAS if you'll be using it for both work and entertainment.
$649, qnap.com

QNAP TS-253E

The TS-253E is a sensible business NAS that's ideal for rolling out to multiple small offices. If you're buying for business, and particularly if you've got an eye on minimising support headaches across a group of premises, this is an excellent choice.
$858, qnap.com

Security software

Avast Ultimate

Buy from retail and this is a bargain, with a solid VPN, anti-tracking software and handy detection fees on top of excellent protection.
~$65, 1 device, avast.com/en-au

THE ALTERNATIVES

G DATA TOTAL PROTECTION
Despite its quirks, G Data provides straightforward, effective and inexpensive protection against malware and other threats to your system. **1 device, US$50, avast.com**

AVAST ONE ESSENTIAL
Essential has the same malware-detection engine as our top choice, but for free. It even includes 5GB of VPN services per month and a few system optimisation tools.
Free, avast.com

NordVPN

NordVPN provides consistent and fast speeds, serious security, great support for video-streaming services and some cost-effective subscription rates.
$59 per year, nordvpn.com

THE ALTERNATIVES

PROTONVPN
ProtonVPN provided one of the best free offerings of all the VPNs in our group test, including unlimited data, but upgrade to benefit from even faster speeds and many more options.
Free, protonvpn.com

SURFSHARK
A strong rival to NordVPN, especially if you're willing to commit to its two-year contract. It's fast, cheap and a fine choice for people who like to switch to US streaming services.
$79.61 for one year, surfshark.com

Bitwarden

Bitwarden has a huge advantage: it's free. It isn't as slick as some paid-for rivals, but it can sync passwords across all devices for no extra charge. **Free, bitwarden.com**

THE ALTERNATIVES

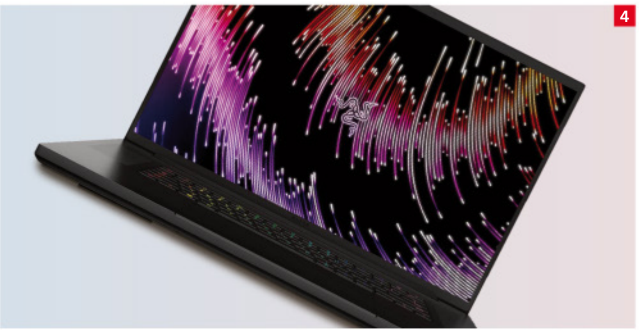
DASHLANE
A manager that's ideal for beginners, and it even builds in an unlimited (if basic) VPN service. Note you may prefer to buy the Family plan ($60 per year) as this extends the service to six people.
$55.99 per year (Premium), dashlane.com

1PASSWORD
1Password is targeted at users who are looking for the last word in security. It even offers a Travel Mode that may ease your mind if surrendering your phone to customs officials. **$54.99 per year (individual), 1password.com**

THE LIST

The best laptop graphics cards

5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3

2

1

© Nvidia, AMD

Easily the most important part of a gaming notebook is its GPU, but choosing based purely on the model of GPU is sadly no longer enough. You now need to know how much power the laptop manufacturer is letting that GPU chow down on, commonly referred to as the TGP. That's why our very favourite current mobile GPU isn't necessarily the most powerful; it's a bit more complicated than that.

5 AMD RADEON 890M

'Integrated' used to be a dirty word when it comes to gaming graphics, but AMD has recalibrated expectations in recent years, and its new Strix Point APUs with their RDNA 3.5 Radeon 890MiGPU is pretty damned impressive. We were already into the 780M and its 1080p gaming chops, but the new 890M of the Ryzen AI 9 HX APUs is another level beyond that. Okay, it's still behind the likes of an Nvidia RTX 4060 discrete GPU for frame rates, but for 1080p mobile gaming on a tight budget, the 890M makes a lot of sense.

Laptops from $1,500, www.amd.com

4 NVIDIA RTX 4090

Put the RTX 4090 in too slim a laptop chassis, and it can even end up slower than a 4080. That's why the 4090 isn't our automatic pick for the top slot. However, give it a proper desktop replacement rig, and there's no doubting that it's the fastest mobile GPU, and by some distance. The problem, then, is pricing. Portables with the 4090 fitted are terrfyingly expensive. In the end, it's hard to justify that premium. But if you're not price sensitive, and want the best possible performance, it has to be a 4090 in a big laptop.

Laptops from $4,000, www.nvidia.com

3 NVIDIA RTX 4070

The fact that this mobile 4070 is really a slightly tweaked RTX 4060 Ti desktop GPU, and thus only offers 8GB of VRAM and a 128-bit memory bus, is slightly annoying. However, with the same level of gaming performance as the mobile RTX 3080 of the previous generation, the RTX 4070 delivers a frame rate experience that belies its pricing in the gaming laptop world. These PCs are seriously affordable, something that wouldn't be possible with the bigger, more expensive GPU from the desktop 4070.

Laptops from $1,600, www.nvidia.com

2 NVIDIA RTX 4060

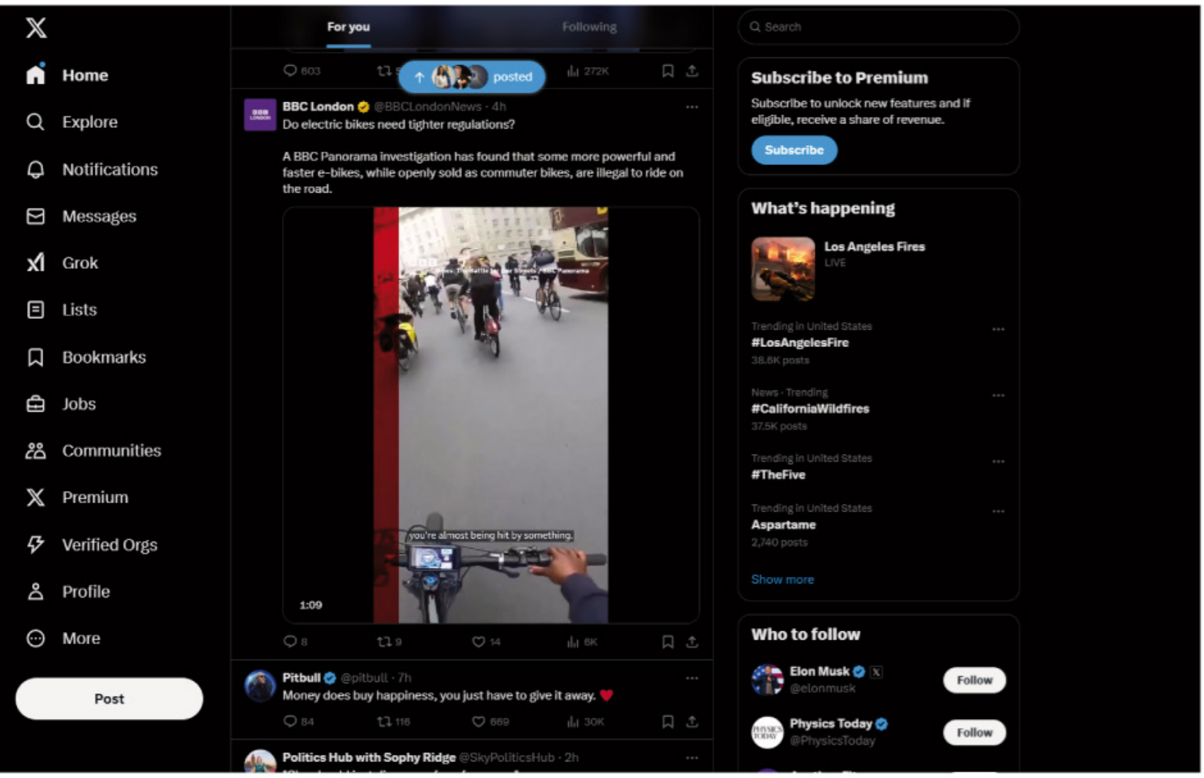
The RTX 4060 delivers genuinely impressive 1080p gaming performance to the sub-$1,000 entry-level gaming laptop market and frame rates that would have been thoroughly mid-range one generation ago. You're also getting DLSS 3 and Frame Gen in the bargain. Obviously, there are much faster mobile chips available, but the price-to-performance compromise is very strong here. When you add in that unbeatable Nvidia feature set, this has to be the best real-world gaming GPU right now.

Laptops from $1,300, www.nvidia.com

1 NVIDIA RTX 4080

The RTX 4080 isn't the most powerful laptop graphics chip, but it offers a great balance between power efficiency and outright gaming performance. You'll be amazed what this GPU is capable of, especially with a little help from DLSS upscaling and frame generation. It's also more affordable than the RTX 4090, even if it's not cheap. What's more, many 4090s get crammed into laptops with limited thermal performance, in which case such 4090s may not be any faster.

Laptops from $3,000, www.nvidia.com ■


Big, bold and filled with drama.

603 272K

BBC London @BBCLondonNews · 4h
Do electric bikes need tighter regulations?

A BBC Panorama investigation has found that some more powerful and faster e-bikes, while openly sold as commuter bikes, are illegal to ride on the road.

you're almost being hit by something.
1:09

8 9 14 6K

Pitbull @pitbull · 7h
Money does buy happiness, you just have to give it away. ♥

84 116 659 30K

Politics Hub with Sophy Ridge @SkyPoliticsHub · 2h

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X $0 / $4.88 / $13 / $35 per month, www.x.com
BLUESKY Free, www.bsky.app

X (formerly Twitter) vs Bluesky

Zak Storey examines the battle of the micro-bloggers.

It's a dangerous business, getting up each morning and heading onto the internet. If you don't keep your feet, there's no telling what dark alley of Reddit you might be swept off to. Social media is divisive right now. From Meta announcing that it's getting rid of its factcheckers, to AI profiles springing up and pretending to be human, to algorithms perpetually drip-feeding you 10-second dopamine reels, it's a challenge to find somewhere that truly is 'social' by its very definition.

With that in mind, and the mass exodus currently erupting from X (formerly Twitter), we decided that it was about time *APC* cautiously waded into the shallows and had a look at the founding father of microblogging in today's age, and how it compares to the new kid on the block, Bluesky.

X has changed dramatically since its initial conception and its purchase by Elon Musk. From paywalls stopping direct messages and more advanced features, to algorithm shifts and advertisements running rampant, what Twitter was, to what X is now, is wildly different. It's still a social media platform, but one that has radically shifted, evolving into something very different.

To be clear, we've seen these kind of mass exoduses before. Social media users often flock to other, more modern platforms in the hopes of finding something new, something better, or something closer to what once was:. This has happened with Mastodon, Threads, and now it's Bluesky's turn.

Centralised vs Decentralised

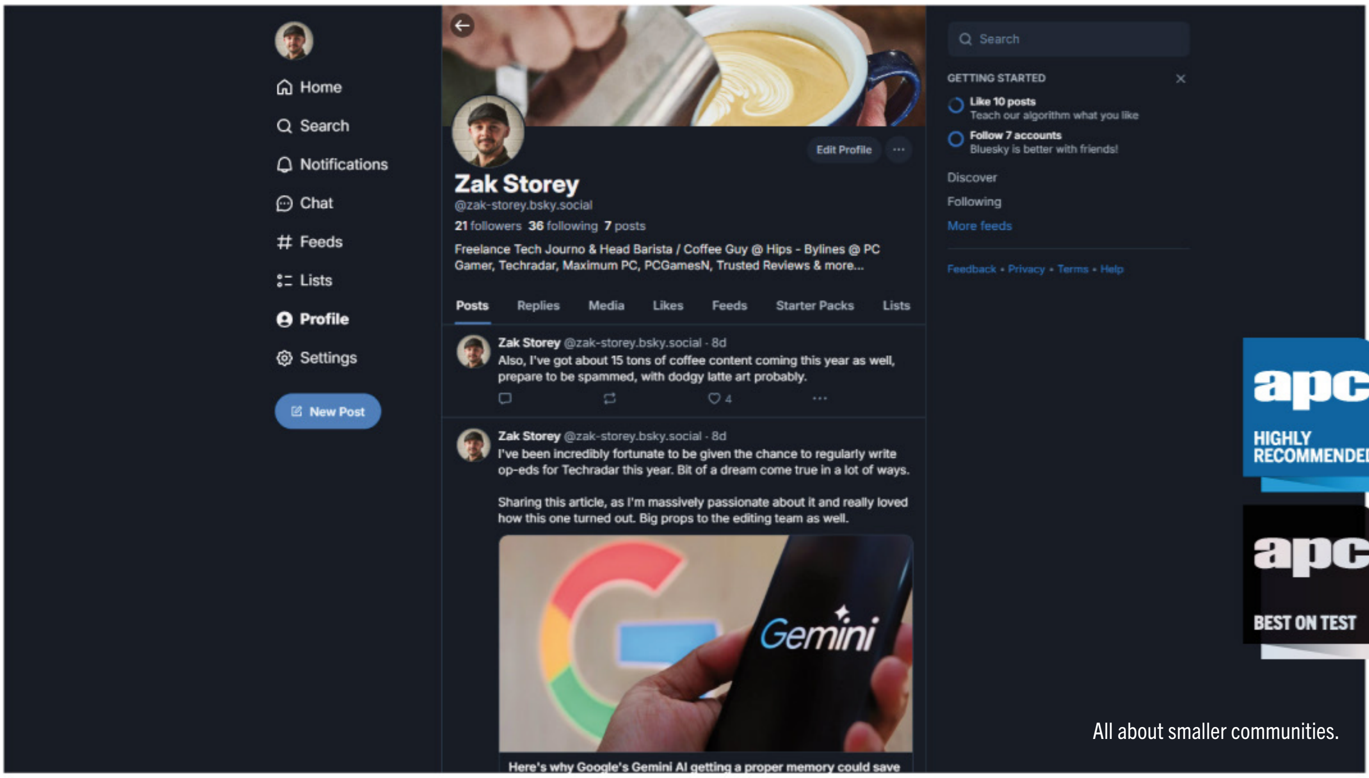
Honestly, this very heading could have a feature dedicated to it in its entirety. The differences between Bluesky and X are deep-routed and intrinsic to the platforms, not necessarily in the content that's shared, but in how they operate at a fundamental level.

In short, Bluesky takes advantage of something called its AT Protocol (Authenticated Transfer). What this allows them to do is effectively decentralise Bluesky from a central server that the company has to manage and maintain.

While something like X manages its own servers, where all of your tweets and information is stored, allowing you to interact with everyone, in the case of Bluesky, individual servers are set up globally by communities that people then join, in not too dissimilar a manner to Discord. The communications, comments, and even moderation are then handled by that server and its community. Think of it like *World of Warcraft*: you play *WoW*, but you can only interact with people on your server, Silvermoon, unless you join another server or 'node'. Bluesky takes that one step further, as, although *WoW* has multiple servers, the data and management of those servers are still managed by Blizzard directly, while Bluesky's servers are more independent.

That does give some major benefits to Bluesky in terms of user data, as you can

© X.com



Zak Storey
@zak-storey.bsky.social
21 followers 36 following 7 posts
Freelance Tech Journo & Head Barista / Coffee Guy @ Hips - Bylines @ PC Gamer, Techradar, Maximum PC, PCGamesN, Trusted Reviews & more...

Posts Replies Media Likes Feeds Starter Packs Lists

Zak Storey @zak-storey.bsky.social · 8d
Also, I've got about 15 tons of coffee content coming this year as well, prepare to be spammed, with dodgy latte art probably.

Zak Storey @zak-storey.bsky.social · 8d
I've been incredibly fortunate to be given the chance to regularly write op-eds for Techradar this year. Bit of a dream come true in a lot of ways.

Sharing this article, as I'm massively passionate about it and really loved how this one turned out. Big props to the editing team as well.

Here's why Google's Gemini AI getting a proper memory could save

GETTING STARTED
Like 10 posts
Teach our algorithm what you like
Follow 7 accounts
Bluesky is better with friends!

All about smaller communities.

apc HIGHLY RECOMMENDED

apc BEST ON TEST

© Bluesky

effectively host your own information on your own 'node' (colloquially a thread in the app) if you wanted to, although again, you'd have to convince people to join it to interact. There's a larger main node that's offered to new users, bsky.social, where you'll find the vast majority of folk, however, so it's not as aggressively decentralised as some alternatives.

In contrast, X is very much a centralised platform, controlled by a single company, and the data on those services is subject to X's own privacy and data policies as a result. That does give you a more seamless experience communicating with people, but it also means that moderation has to be handled by X directly, rather than through community groups (although again, it is worth pointing out that Bluesky does have its own moderation systems as well).

Features on Features

If you're after features, gimmicks, and gizmos, X is the place to be. It's at this stage wildly advanced compared to what Twitter used to be, covering everything from lists and bookmarks to communities, jobs, and even its own AI assistant in the form of Grok, an xAI application.

It also features multiple premium subscriptions, with 'Basic', 'Premium', and 'Premium+', each adding additional features. The basic package gets you a 'small reply boost', encrypted direct messages to anyone, bookmark folders, highlights tab, an edit button (yes, really), and longer posts and videos.

Premium halves the number of ads you see, applies a larger reply boost, gives you a blue checkmark, and disables any limits on Grok, alongside returning the Tweetdeck or X Pro functionality and providing analytics; Premium+ removes ads, gives you the largest reply boost, and lets you write full-blown articles. All those tiers can be paid either annually or monthly. Monthly subs are $4.88, $13, and $35 per month, and the annual variants seeing discounts ranging from 11 to 13 percent.

Bluesky, on the other hand, currently has no subscription models, and its overall setup is incredibly similar to what Twitter was a decade or so ago, if not more. There's your home, search, notifications, a fairly rudimentary chat or messaging system, Feeds (where you select which nodes you want to follow or discover), lists, and that's about it.

Which is better?

It's a tough one to call. Politics aside, the very fact that Bluesky doesn't push you into any algorithms – just an uncurated timeline of posts from the people you follow – is a breath of fresh air. It does, however, lack a lot of the features that made X great in its heyday. Sadly, however, as so many of those are now locked behind a subscription, that too has lost its sheen considerably.

Things like Tweetdeck were vital tools for professionals, journalists, PRs, and budding journalism graduates alike to keep abreast of the latest news and press releases – directly and carefully interacting with their communities. Yet, that's still a tool that Bluesky lacks. From a user experience perspective, if you've used one, you'll be more than comfortable using the other. Jack Dorsey's influence on both is clear to see, and that micro-blogging aesthetic seems relatively concrete at this point.

Still, for all the hubbub and drama surrounding the huge number of people departing X for greener pastures, we wonder whether perhaps it's less about the political drama currently unfolding, and more a purer desire to return to a time where social media was simpler, more direct, and more in our control, where we weren't the product. Whether it's decentralised or not seems to matter little. ■

VERDICT

★★★½☆

X Broad feature set; Larger community; integrated AI; Simple to use. But riddled with ads and subscription services; Political drama.

★★★★☆

Bluesky Simpler to use; Decentralised benefits; More community driven. Fewer features than found on competitors.

GADGETS

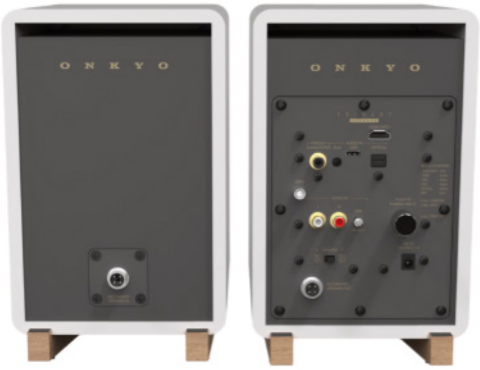
Nice things to have

Onkyo Creator GX-30ARC

As good as the speakers built in to your computer can be, they're still no substitute for a proper stereo setup, especially if you like to listen to music, watch movies, or fashion your own crowd-pleasing creations. That's where Onkyo's new Creator GX-30ARC comes in.

Available in black or white as part of a wider Creator series family that also includes the GX-10DB, the GX-30ARC comprises a pair of active desktop monitors, each containing a 4-inch woofer, 3/4-inch tweeter and driven by an integrated 2x25W Class D amplifier. They're also festooned with connectivity options including Bluetooth, USB-C, HDMI ARC, digital optical, RCA (phono), a subwoofer pre-out and a 3.5mm aux port. You even get a pair of angled stands to get your listening enjoyment just so, plus an infrared remote so you can enjoy great sounds from your sofa.

$US$299 (about AUD$480) | onkyo.com



The Creator GX-30ARC comes with an HDMI ARC port and can even be used to hook up to a vinyl turntable.

InkPoster

Tired of staring at the wall? Why not stare at an ever-shifting gallery of wall art instead? Pocketbook's InkPoster is a digital art poster that uses e-ink technology to display all kinds of colourful, attention-grabbing pieces, with display sizes ranging from 13.3 inches to 31.5 inches. Naturally each Wi-Fi and Bluetooth-equipped frame comes with gallery containing thousand of pieces of artwork for your to choose from, plus your experience promises to be glare-free and long-lasting – each InkPoster's battery lasts for up to a year between recharges.

From US$599 (about AUD$960)
inkposter.com

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Choose from thousands of artworks carefully curated by art consultants. Or display your own memories.

Nanoleaf LED Light Therapy Face Mask

Having trouble recognising that tired, haggard person looking back at you in the mirror? Then you may need one of these. Availalable later this year from smart lighting maker Nanoleaf, the LED Light Therapy Face Mask uses red and Near-LED lighting (medically approved to FDA Level 2 standard in the US) to help combat fine lines, uneven skin tones and even acne. Place it over your face and you'll be able to use one of the Mask's seven settings to get the light treatment that's right for you. Talk about putting your best face forward.

$TBC | **nanoleaf.me**

Corsair K65 Plus

Chiefly famous for making PC peripherals, Corsair is inviting Mac users to join its gaming party with this – the K65 Plus wireless keyboard. Available in Glacier Blue and Frost colours and with Corsair MLX Red v2 linear switches, the K65 Plus is a Mac-focused version of the identically named PC keyboard it launched early last year. Promising silky smooth typing and ultra-fast responsiveness, the K65 Plus can be paired with the matching M75 mouse, which has been designed for left- and right-handers.

$240 | **corsair.com**

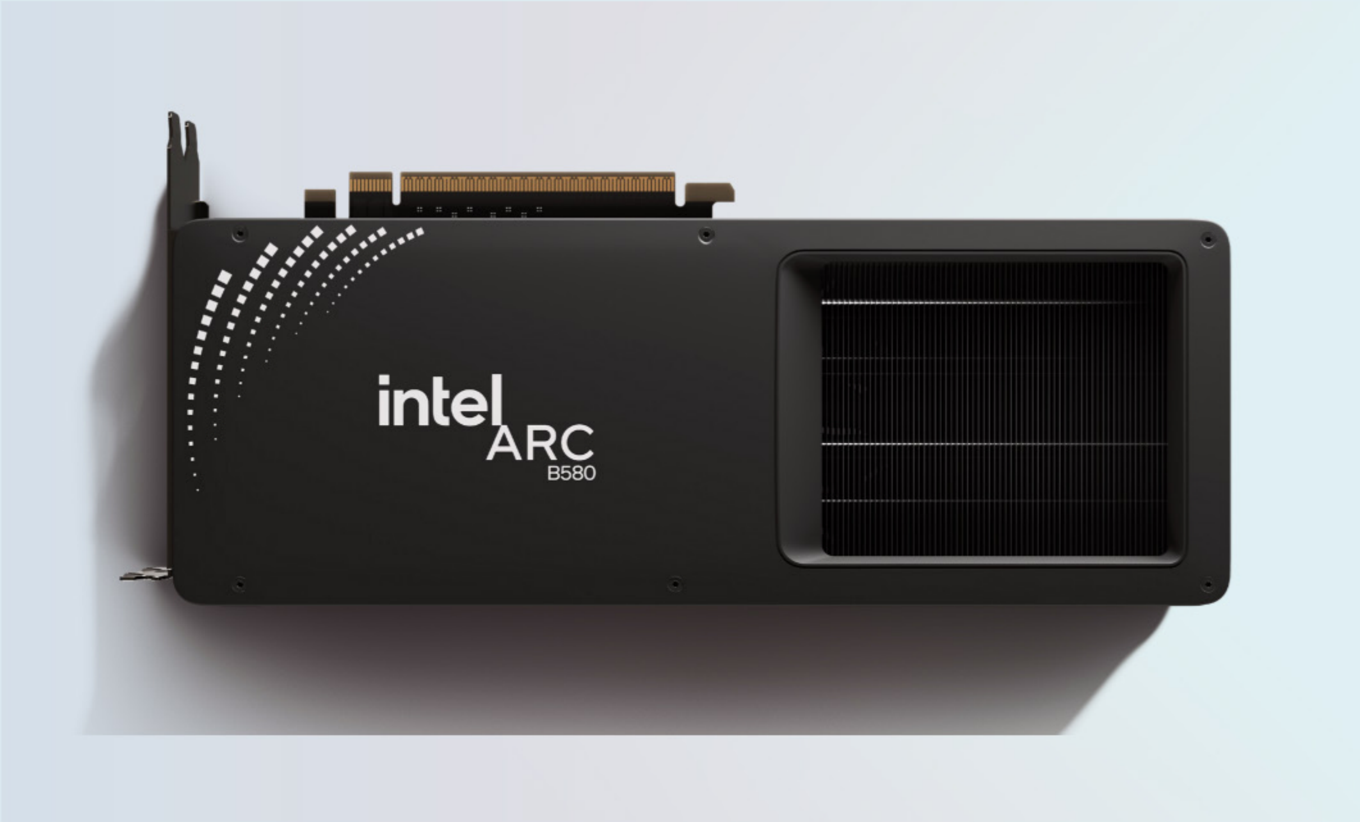
LaCie Rugged SSD Pro5

Aimed at digital creators or anyone who wants a tough solid-state drive for life on the go, the new LaCie Rugged SSD Pro5 is a thing of wonder. Dust- and waterproof to IP68 and further protected by a blue rubber enclosure, it's available in 2TB or 4TB storage capacities with read/write speeds of 6,700/5,300MB/sec. It's also equipped with Thunderbolt 5 for superfast data transfers between it and compatible devices, which are certainly becoming more common. One for your kit bag for sure.

From $373 | **seagate.com**

REVIEWS

Expert reviews and recommendations to help you buy with confidence



35 Intel B580 36 Asus ROG Swift OLED PG27UCDM 37 Lemokey G1 38 Asus RT-BE92U
39 Asus ROG Pelta headset 39 MSI Datamag Magnetic Portable SSD

40 **Nvidia RTX 5080 group test** 42 Asus ROG Astral GeForce RTX 5080 16GB GDDR7 OC 43 Aorus RTX 5080 Master
44 MSI RTX 5080 16G Suprim SOC

APC is Australia's oldest consumer technology magazine – having been consistently in print for over forty years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, and beyond. We have two goals: to find the best modern tech and to help you make the most of it.

Independent reviews

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three attributes.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

Labs testing

APC strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance including storage read and write speeds, gaming and battery life.

APC EDITOR'S CHOICE

When a product scores 4.5 out of 5, it carries the Editor's Choice Award. These are products that exceed expectations and deliver a quality experience up there with the very best.

APC HIGHLY RECOMMENDED

You will see this award if a reviewed product has scored four out of five stars. It means most people can expect satisfying performance from the product, and that we would use it ourselves.

PRICE $479 **WEB** intel.com

Intel Arc B580

A bang for buck GPU that delivers big performance for budget-conscious gamers.

Intel isn't a big player in the discrete GPU market but, nevertheless, the recently launched Arc B580 makes key design choices that have resulted in a new favourite in the budget gaming segment. Priced from around $449, the B580 delivers impressive 1080p and 1440p performance, outclassing similarly priced alternatives from Nvidia and AMD.

The B580 features a dual-slot, 272 mm long design with a single 8-pin power connector, a twin-fan cooler and the ability to drive 4 monitors. Despite a 17% reduction in compute units compared to the older Intel A580, and a 10% decrease in transistor count overall, the higher 2850MHz boost clock and increased efficiency means the B580 gives noticeably better performance. The GPU features 12GB of GDDR6 RAM with a wide 192-bit memory bus (compared to the 128-bit interface on competitor cards), meaning larger textures can be processed more efficiently, improving 1440p gaming.

We put the B580 to the test with a comprehensive array of benchmarks, and compared against cards such as the (similar price) RTX 4060, the (more expensive) RTX 4060 Ti and AMD RX 7600 XT. In synthetic tests like 3DMark, overall the B580 is about 10% faster than the AMD RX 7600 XT and RTX 4060, and about 10% slower than the RTX 4060 Ti – except where the B580's extra RAM and memory bandwidth come into play, and it pulls ahead. We didn't have an AMD RX 7600 (which is slightly cheaper than the B580) on hand for testing, but comparing to older benchmarks puts the B580 well ahead.

For 1080p gaming at ultra-high detail levels (with ray tracing off) on titles such as *Cyberpunk 2077*, the B580 bests the RTX 4060 by around 7%, but is up to 17% faster at 1440p. Versus the RX 7600 XT, it gives very similar frame rates at 1080p, but is 5% faster at 1440p. The B580 is mostly on par with the 25% more expensive RTX 4060 Ti at 1440p, but the latter is an average of 7% faster at 1080p. Overall, the B580 is one of the best buys for 1080p gaming, and has the added bonus of punching way above its weight in 1440p gaming.

While ray tracing isn't a prime focus for budget gaming cards, the B580 is decent – not quite at Nvidia's level, but better than AMD. It does tend to lag behind the competition when it comes to upscaling, and performance in 3D applications (such as our Blender test) is slightly worse than Nvidia and AMD cards, which are better optimised for such workloads. On the plus side, driver stability has also improved dramatically compared to previous-generation Intel GPUs, and the B580 was rock solid during testing. It was also very quiet, and temps peaked at 55°C under load, with no thermal throttling.

Intel has also released the B570, which is around $50 cheaper, and has fewer shaders, a lower boost clock, and reduced RAM on a narrower memory bus. It's not as good for 1440p gaming, but at 1080p, it's about 10% slower, and sells for 10% less – if you can find it for sale. We do expect next-gen budget GPUs from Nvidia and AMD in the next few months – though it remains to be seen whether they will be priced competitively enough to appeal to gamers over the current models. ■

BENCHMARK RESULTS	Arc B580	RTX 4060	RTX 4060 Ti	RX 7600 XT
Street Price	$449	$439	$539	$529
3DMark Time Spy Extreme	7,019	5,021	6,250	5,422
3DMark Fire Strike Ultra	8,216	5,731	7,111	7,547
3DMark Steel Nomad	3,039	2,415	2,712	2,451
3DMark Speed Way	2,478	2,711	3,254	2,145
3DMark Port Royal	7,858	6,089	8,251	6,001
Blender 4.3 Monster	925	1,421	1,677	687
Geekbench 6 (OpenGL)	96,250	106,100	128,330	97,745
Cyberpunk 2077 - 1080p	96	81	96	85
Cyberpunk 2077 - 1440p	63	44	63	55
Shadow of the Tomb Raider - 1080p	106	106	122	111
Shadow of the Tomb Raider - 1440p	62	55	64	61
F1 23 - 1080p	91	88	99	91
F1 23 - 1440p	64	62	66	61
Warhammer III - 1080p	67	61	69	67
Warhammer III - 1440p	47	41	45	46

Gaming (average frame rates) **Settings:** highest detail level, RT and upscaling off

SPECS 2,560 shaders; 2,850MHz boost clock; 12GB GDDR6 19Gbps memory, 456GB/s memory bandwidth; 3x DisplayPort 2.2, 1x HDMI 2.1; 190W TDP, 1x 8-pin power connector.

VERDICT

★★★★★

The Intel B580 is easily the best value option for budget-conscious gamers who want strong 1080p performance and the ability to drive a 1440p display.

Lindsay Handmer

PRICE $2,099 **WEB** https://rog.asus.com/monitors/27-to-31-5-inches/rog-swift-oled-pg27ucdm

Asus ROG Swift OLED PG27UCDM

Asus' 27-inch OLED monitor is a pricey screen purpose built for enthusiasts.

OLED 4K monitors are finally becoming more accessible, with the brilliant panel technology now available on 27-inch gaming displays. Beating many manufacturers to the punch is, as usual, Asus with the ROG Swift OLED PG27UCDM. It will be an attractive option among enthusiasts craving high framerates on a conveniently sized, gorgeous panel. However it does come with some tradeoffs that are very, well, gamer-y.

The PG27UCDM is no doubt a gorgeous monitor, and it offers the peak performance that many desktop users are looking for – it's the extra stuff core to the ROG brand that may be a deal breaker. An aggressively large tripod stand and a projector that doesn't seem to do anything except shoot the red ROG logo down onto the surface of your desk are at the forefront of my complaints. I like my games beautiful, but I'm also looking to get stuff done, so these things more or less get in the way on my small desk or are just pointless.

It doesn't help that, despite being one of the first 27-inch 4K OLED gaming monitors, it's quite a pricey unit. At $2,099, it's priced on par with and above what you could spend on a 32-inch 4K OLED gaming monitor. Such large monitors are more appealing if you're looking to get some productive work done, if you like more casual, graphically intense games, or if you just generally prefer big screens. The 4K panel also typically looks better on a 32-inch screen than a 27-inch one down to the pixel density.

The 27-inch size is more intended for *Counter Strike* and *League of Legends* fanatics, where it is a good sweet-spot between big enough and not causing your eyes too much strain as they dart around, and we can appreciate this screen for that. Adding to this is a satisfying 240Hz refresh rate (0.03ms response time) and, no doubt, the 4K display (though I'd suggest an avid gamer would be comfortable with a 1080p panel). No doubt the monitor aces the assignment of showing a beautiful picture.

Peak brightness and HDR (HDR10 and Dolby Vision compatible) were sufficient and, coming back to the RGB, you're given a fair amount of control in customising the colours of the backlighting. At the time of review the monitor did not include support for Aura Sync (Asus' RGB programming tool on Windows) but this will surely be a feature later on. The screen has an anti-reflection coating, and to prevent OLED burn-in, there's a feature called Asus OLED Care which can be activated via the monitor's physical buttons. Those physical buttons give you a great amount of control over the monitor's settings and I truly love them.

Power is delivered via a common C13 plug (<80W consumption) and the assortment of ports is quite generous, even including a 90W USB-C port and three USB-A ports for your peripherals (wired to your PC via a USB-B to USB-A cable). Two HDMI ports, a DisplayPort and an earphone jack are also fitted behind the display.

Ultimately, this is a brilliant monitor for an avid gamer but its focus on looking like a superweapon may not be appealing to all users. It's uniform with Asus' ROG monitor styling, but it feels at odds with the realities of mass market appeal. ■

SPECS 27-inch, matte, 3,440 x 1,440, HDR10/Dolby Vision, 240Hz, OLED. 0.03ms response time. 450-nit brightness (1,000-nit HDR). 1,500,000:1contrast. 2x HDMI 2.1, 1x DisplayPort 2.1 out, 3x USB-A 3.2 Gen 1 downstream, 1x USB-B 3.2 Gen 1 upstream, 1x USB-C 3.2 Gen1 downstream (90W PD). Tilt, Swivel and Height adjustment: Yes (+30° ~ -30°/ 0~110mm). 61.03 x 54.95 x 21.88 cm, 7.62KG.

VERDICT

★★★☆☆

A nice OLED panel and a quirky design that looks like it's from planet Mars.

Zachariah Kelly

PRICE $99 **WEB** www.lemokey.com

Lemokey G1

Affordable, simple, and feature-rich.

Though sister brand Keychron does sell some obviously gamer-orientated mice, that's really Lemokey's gig. For the G1, that starts with the 8,000Hz polling rate, a feature usually the preserve of high-end gaming mice from the likes of Logitech or Razer at twice the price. That makes the Lemokey an excellent entry-level pro-level mouse for super-competitive gamers, right?

Not exactly. I've checked out the performance of the Pixart 3950 sensor in the Lemokey mouse, and while in general use at 1,000Hz the mouse performs admirably, as soon as you spike it up to 8,000Hz, the data points start to look weird. That's because it's not polling at the stated rate. Where it ought to be polling eight times each millisecond, I was seeing anything from three to five counts, but never the full eight.

Despite that failing, this is still a great little mouse – and I do mean little. The Razer DeathAdder V3 Pro has been my go-to gaming mouse since its launch, but having used the G1 for a good few weeks, going back to the DeathAdder feels massive. As a dyed-in-the-wool claw-gripper, the Lemokey's diminutive stature actually works for me.

It's super-light, too. In fact, it's lighter than the latest Logitech G Pro X Superlight 2 Dex, with the same general heft as the Razer DeathAdder V3 Hyperspeed that I love so much, and none of that horrible cut-out shell design that makes a host of other dedicated lightweight gaming mice a trypophobe's nightmare.

While this simple, pared-back design looks and feels like a very basic mouse, the Lemokey G1 does absolutely everything you could want from a wireless gaming mouse, and at a very reasonable price. The 2.4GHz connection is solid – with only a little pause when I'm first booting up my PC and everything is loading in – and is otherwise latency free in-game. Its tracking is right up there, too, with 750 IPS and 50G pace and acceleration. Basically, it's going to follow every one of your rampant flicks and spasms in whatever tense gaming situation you find yourself in.

> "None of that horrible cut-out shell design that makes a host of other dedicated lightweight gaming mice a trypophobe's nightmare."

So what if it's not that stylish? That means there's no RGB illumination to steal away any of its extensive battery life, with just a token light around the underslung DPI/profile switch to show which setting you're on. Even if you were to run it exclusively with the draining 8,000Hz mode turned on, you'd still be looking at a 40-hour battery life. I would expect double that at 1,000Hz, and Lemokey promises 140 hours if you don't care about latency and are happy to put up with the Bluetooth 5.1 connection. Maybe that's fine for Keychron, but over here in Lemokey land, we like our 2.4GHz connection, thank you very much. I will say that I'm on the fence about the web-based configuration app, and I find it slightly odd that I can seemingly only access the settings when I'm wired in via the USB Type-C cable.

Anyway, even with the Razer DeathAdder V3 Pro sat in a box next to me, I'm finding no reason to swap back from the Lemokey, especially after how big the Razer rodent now feels in my hand, and that's always a key thing for me when I review anything. How gutted am I going to be when I have to give this thing back? Maybe I won't quite be gutted when the Lemokey goes, but I will miss it. ■

VERDICT

★★★★☆

Attractive price point; Great battery life; Light and responsive. Dubious 8K polling rate; Slightly rough chassis finish.

Dave James

PRICE $424 **WEB** https://rog.asus.com/au

Asus RT-BE92U Wi-Fi 7 Router

A premium, consumer-grade Wi-Fi 7 that doesn't cost the Earth. Is this your next router?

apc
EDITOR'S CHOICE

The Wi-Fi 7 router market is finally maturing and prices are plummeting. Into it has launched Asus' RT-BE92U – a premium domestic device that's targeted at power users, with smart homes, that demand performance, features, security and multiple-network segregation. We've seen all this before on expensive models but, on one that costs around $400? Could this be the sweet-spot router we've been waiting for?

The first thing to note is that this is one of the better-looking routers: it's not a giant, mecha-space spider, nor is it a simple white tube. It's got some geometric design flourishes, a smart, red stripe and it doesn't take up much desk space. It also comes with a wall-mounting bracket.

Set-up is simple thanks to the well-polished Asus router app. The first screen then gives an overview of your network with real-time traffic visualisations and various wired and wireless network maps. The latter includes Asus' AiMesh devices which can be old Asus routers used as network-extending nodes. There are also QoS controls that let you choose the order of priority of tasks like gaming, streaming, WFH (etc).

The second screen gets granular in terms of device management. You can block them and add suitable QoS controls. You can also assign them to family members and set 'Safe Browsing' rules which can block various combinations of malicious website traffic, various types of website content and ads.

An Ai insight tab gives advice on unused features, insights and threats. This can include activating Asus' AiProtection (network protection powered by Trend Micro) which, refreshingly, doesn't require an additional premium subscription. The Family tab provides access to myriad parental controls – you can assign devices to groups of users and apply limits to them. The final, 'Settings' tab provides access to all traditional Wi-Fi router settings plus the ability to connect to Google Assistant and Alexa voice controls. There's also a list of optional Asus networking apps including media players, Ai camera managers and various other tools.

While the app provides access to numerous features, accessing the firmware via a web browser opens the door to many more. Of particular interest to enthusiasts will be those relating to the faster-than-usual USB-A 3.2 Gen 1 port which allows attached devices to be used as a file server, BitTorrent downloader, print server, Time Machine backup or a WLAN connection. It's got almost everything the most-demanding consumer might want and only advanced, business-grade users might grumble.

As for performance, it's got 10Gbps and 2.5Gbps LAN/WAN ports and three 2.5Gbps LAN ports – very impressive. We tested Wi-Fi performance in our single-storey Sydney weatherboard cottage by downloading large videos from a Synology NAS to a laptop, up close, two rooms away and 15m away in the garden and saw transfer speeds of 1,480Mbps, 384Mbps and 160Mbps respectively. All of these are excellent for an individual router and are only significantly beaten by top-tier, multi-node systems.

So, it's fast, feature-packed and it even looks good too. At $424 it's also excellent value and is our new Editor's Choice. ■

SPECS Speed: Wi-Fi7 9,700Mbps | Connectivity: 1 x 10Gbps WAN/LAN, 1 x 2.5Gbps WAN/LAN, 3 x 2.5Gbps LAN, USB 3.2 Gen 1 | Features: 2GHz quad-core CPU, parental controls, QoS, Alexa and Google voice assistants, Asus AiProtection.

VERDICT

★★★★★

The Asus RT-BE92U doesn't put a foot wrong.

Nick Ross

SPECS 50mm Dual Drivers; Frequency Response: 20Hz - 20,000Hz; Battery Life: 90 hours, 60 hours (RGB on); Connection Type: Wireless 2.4 GHz, Bluetooth 5.2, USB-C; Mic: Removable with mute button; Weight: 309g.

PRICE $269 **WEB** rog.asus.com/headsets-audio

Asus ROG Pelta wireless gaming headset

Asus' latest gaming headset has blown me away.

The ROG Pelta is just brilliant. This ultra-comfortable and stylish headset has quickly become one of my favourite headsets, backed up by its brilliant sound quality and value.

Priced well below the top-end $369 ROG Delta II, the Pelta packs high-end sound quality with its 50mm titanium-plated diaphragm drivers. It also sports a brilliant 90 hour battery life, or 60 hours with the RGB lights on. Its settings (including sound and microphone quality adjustments) can be tweaked in the ROG Armory crate application, along with the small RGB logo on both cups.

The headset is capable of both Bluetooth and USB-C connectivity (no 3.5mm jack), and comes with a wireless USB-C dongle for dedicated wireless use. Compared to other headsets I've tested, it's able to hold stable upstream and downstream audio at quite a long distance and through thick walls.

I loved the inclusion of the pause/play button below the volume wheel, and I like the combination of the power off/on toggle with a slider that switches between dongle and Bluetooth connectivity. The microphone mute button also comes in handy.

The only two things I'd change about the headset is that I'd like there to be greater fit adjustment, as there's currently only three fit options. The plastic material also feels quite basic, but both of these criticisms can be forgiven for the price.

If you're after a PC headset without an astronomical price, but still want premium performance, the ROG Pelta is the gadget to beat. ■

VERDICT

★★★★★

An incredible gaming headset that holds its own against the best on the market.

Zachariah Kelly

SPECS 1TB, 2TB, 4TB (coming soon) capacity; 20Gbps interface; Read: 1,642 MB/s, Write 1,514 MB/s; Magsafe compatible; Warranty: 5 years; Weight: 81 grams; Dimensions 66 x 66 x 13mm.

PRICE From $159 **WEB** msi.com

MSI Datamag portable SSD

A 20Gbps interface and a magnetic attachment system make this drive one of a kind.

The MSI Datamag stands out from competing portable SSDs thanks to the 20Gbps USB connection and drive rated at 1,500 MB/s writes, and 1,600 MB/s reads. Similarly priced competition like the Sandisk Extreme and Samsung T7 top out at 1,000 MB/s, while expensive models such as the Sandisk Extreme Pro hit 1,900MB/s.

The MSI Datamag uses a Phison PS2251-U18 controller and 3D NAND, and on a USB 4 connection, we managed peaks of 1,660 MB/s reading and 1,860 MB/s writing using the ATTO disk benchmark. We also sustained 1,642 MB/s reading and 1,514 MB/s writing in Windows, easily exceeding the rated speeds. The tough aluminium construction and heat sink fins help keep the SSD cool under prolonged load, and we didn't get any thermal throttling even in sustained 30-minute read/write tests.

As the name suggests, it has a magnetic attachment system that can snap onto your existing MagSafe phone, case, or other accessories, or be attached to whatever you want using the included stick-on metal rings. This system works very well and is a surprisingly useful feature not found on other portable SSDs. You also get a long and a short USB-C cable, plus a USB-C to USB-A adapter.

While the 4TB model is not yet available, the 2TB variant has an affordable RRP (and street price) of $270, while the 1TB capacity is $160. Combined with the long 5-year warranty, the MSI Datamag is a very compelling SSD for those who need a high-performance drive. ■

VERDICT

★★★★½

Blazing fast, fairly priced, and effortlessly snaps onto a phone or other device with its magnetic attachment system.

Lindsay Handmer

Nvidia RTX 5080 group test

A new graphics card built for silicon austerity and a new era of AI rendering. Lindsay Handmer and Jarrod Walton hit the Labs to find out more.

SUPRIM
GEFORCE RTX
SUPRIM
AORUS
GEFORCE RTX

The Nvidia GeForce RTX 5080 takes the honour guard position for the RTX 5090. In times past, the penultimate Nvidia GPU of each generation has often been the best overall pick. But the gap between first and second place has widened significantly in the past two generations, at least for 4K gaming and other demanding workloads. The 5080 also takes over from the RTX 4080 and RTX 4080 Super, often with only modest gains. It may still be one of the best graphics cards when the dust clears, but it doesn't have the wow factor of its big brother.

Both the RTX 5080 and RTX 5090 are on sale now, and the moment they became available quickly sold out. While we anticipate a lot of demand for the halo card, the 5080 will hopefully be more readily available – but probably only after the initial wave of eager buyers clears. And there's still the risk that businesses looking for affordable AI hardware might drive inventory shortages because while the 5080 can't match a 5090 in raw performance, two of them would certainly provide plenty of computing for nominally the same price.

Under the hood

RTX 5080 has the same core feature set, meaning stuff like native FP4 support that could entice AI researchers and developers. But it still 'only' has 16GB of VRAM, and many AI models tend to be voracious when it comes to memory requirements – though DeepSeek has certainly shaken many of the foundational thoughts about AI training and inference, as well as impacting Nvidia's stock price.

The succinct story for the RTX 5080 is that, outside of certain AI workloads and MFG, it's currently a pretty minor upgrade over the prior generation 4080 cards (the 4080 Super was only a few percent faster, with its primary attraction being a price cut compared to the vanilla model). The specs basically say most of what you need to know.

The biggest change, outside of AI and MFG, is support for faster GDDR7 memory. The RTX 5080 has 960 GB/s of bandwidth, compared to 736 GB/s on the 4080 Super and 717 GB/s on the original 4080. So, depending on your point of reference, that's 30–34 percent more bandwidth, a pretty sizable upgrade.

But in core processing power, ignoring the new native FP4 number format support, the upgrades are far less impressive. RTX 5080 has 84 Streaming Multiprocessors (SMs) and 10,752 CUDA cores, compared to the 4080 Super's 80 SMs and the 4080's 76 SMs. Clock speeds are slightly higher in theory, but in practice, it's mostly a wash. Raw compute ends up being 8% more than the 4080 Super and 16% more than the 4080.

Upgrade considerations

Most of the other specs scale with the number of SMs, so there's a similar potential 8% and 16% uplift in tensor compute for the existing FP8, FP16, and other formats. However, Blackwell adds

GEFORCE RTX

native FP4 support (Ada relied on FP4 running as an FP8 calculation), which doubles the potential throughput if you don't need the higher precision of FP8. That's where the 1.8 petaFLOPS of compute comes from, compared to just 836 teraFLOPS on the 4080 Super.

ROPS is the same 112 count on the 5080 and 4080-class GPUs, so pixel shading throughput hasn't changed. Ray tracing, on the other hand, sees another doubling in ray/triangle intersection calculations, and Nvidia says the 5080 offers 170.6 teraFLOPS of RT compute, compared to 121 and 113 teraFLOPS of RT on the 4080 Super and 4080, respectively.

There's also a new PCIe 5.0 interface, though that shouldn't matter much for most tasks. The biggest benefit will be for multi-GPU configurations running AI and GPGPU tasks – not for gaming, which no longer has NVLink or multi-GPU support. Power consumption also sees a modest bump from 320W with the previous generation to 360W with the 5080.

Pricing and availability

The good news is that the RTX 5080 won't cost more than the outgoing RTX 4080 Super. Or that's the theory. It's really going to depend on supply and demand, and as we've seen with the dwindling inventories of RTX 4080 and 4090 parts over the past few months, there's still enough demand to push prices up if Nvidia doesn't provide an adequate supply. And, much to no one's surprise, Nvidia says the 5090 and 5080 may experience stock shortages in the coming weeks.

Why isn't that a surprise? Because there's a limited number of TSMC wafers to go around right now. Every GB202 or GB203 wafer that Nvidia orders means one less GB200 wafer and Nvidia previously said its Blackwell B200 supply is already allocated for 2025. That means there's limited incentive to produce a bunch of consumer GPUs that sell for an order of magnitude less money than the most powerful data centre parts.

That means we'll likely see third-party AIB (add-in board) partner cards selling for inflated prices. They launched in Australia for between $2,000 and $2,200, with OC models with better cooling coming close to $2,400. This closely matches the current price of RTX 4080 cards, so it's a relatively sane affair for the moment. If there's a supply deficit, then we aren't likely to see many base-price cards after the initial stock lands. Hopefully, the shortages won't be as severe as we saw with the 3080 cards in 2020–2021 (those were driven by cryptomining), but only time will tell.

To help keep things in perspective, the king of the hill RTX 5090 starts at just over $4,000 for basic partner cards like the MSI Ventus or Asus TUF, and rockets skywards to the most expensive currently at a staggering $5,700 for an Asus liquid cooled ROG Astral OC. Wow…

But we're here for the RTX 5080 today, so let's see what the testing brings.

NVIDIA 50 SERIES	MSI RTX 5080 16G Vanguard SOC Launch Edition	Gigabyte RTX 5080 Gaming OC	Asus ROG Astral GeForce RTX 5080 16GB GDDR7 OC	RTX 5070 Ti	RTX 5070
CUDA cores	10,752	10,752	10,752	8,960	6,144
Boost clock (GHz)	2,745MHz	2,730MHz	2,790MHz	2,452MHz	2,510MHz
Base clock (GHz)	2,295MHz	2,295MHz	2,295MHz	2,300MHz	2,150MHz
Tensor core TOPS	1,801	1,801	1,801	1,406	988
Ray tracing core TFLOPS	171	171	171	133	94
Memory	16 GB GDDR7	16 GB GDDR7	16 GB GDDR7	16 GB GDDR7	12 GB GDDR7
Memory bus width	256-bit	256-bit	256-bit	256-bit	192-bit
Total Graphics Power (watts)	360	360	360	300	250
Required system power (PSU wattage)	850	850	850	750	650
Power connector	1x 450 W PCIe Gen 5 OR 3x PCIe 8-pin adapter	1x 450 W PCIe Gen 5 OR 3x PCIe 8-pin adapter	1x 450 W PCIe Gen 5 OR 3x PCIe 8-pin adapter	1x 300 W PCIe Gen 5 OR 2x PCIe 8-pin adapter	1x 300 W PCIe Gen 5 OR 2x PCIe 8-pin adapter
RRP	$2,299	$2,599	$2,799	~$1,800	TBC

GEFORCE RTX
REPUBLIC OF GAMERS
apc
HIGHLY RECOMMENDED

PRICE $2,799 **WEB** asus.com

Asus ROG Astral GeForce RTX 5080 OC Edition

Is it worth paying more for a premium factory OC RTX 5080?

For those wanting a high-end RTX 5080 with an aggressive factory overclock, extra cooling innovations, and quiet operation, the Asus ROG Astral RTX 5080 OC Edition stands out. At $2,799 RRP, it's on the higher end of the price scale, and while availability is limited (like most 5080s), the preorder offers are at RRP at least.

The Asus ROG Astral gets a higher-than-most factory overclock, with a boost clock of up to 2790 MHz when running flat out. This results in an average 4% performance gain over the standard RTX 5080, while further manual tuning allows it to comfortably hit 10% over stock speeds without stability concerns or any major temperature increase.

That's thanks to the mighty cooling system, which in a unique move, uses a quad-fan design. While most RTX 5080s feature a triple-fan setup with a rear backplate cutout, Asus has placed a fourth fan on the back of the card. This allows for more densely packed heatsink fins (which Asus claims improves thermal efficiency) – though our measurements show the fins are no more tightly spaced than other 5080s we have tested. A vapour chamber and eight heat pipes distribute thermal loads efficiently, and notably, Asus has opted for a phase change thermal pad on the GPU core, rather than traditional thermal paste, which lasts longer.

Like most premium 5080s, the Astral includes a dual BIOS switch, providing flexibility between Performance Mode and Quiet Mode. In Performance Mode, temperatures at idle are 45°C and peak at 67°C, with noise levels measuring 38 dB, with mild coil whine. Quiet Mode reduces noise slightly to 36 dB, and the temp drops to 65 °C. Sound level is much reduced at lower loads, but quiet mode is a few percent slower overall.

Physically, the card is larger and heavier than most, with a footprint of 358 x 149 x 76 mm and a measured weight of 2.866 kg. Despite the bulk, the design remains understated, with RGB lighting integrated along the top rather than in behind the fans. Asus includes an easy to install extending GPU support bracket, though note that it does not physically attach to the card, so can be dislodged if the computer is moved.

One notable addition is the inclusion of dual fan headers on the GPU itself. These allow users to connect case fans directly to the card, enabling them to ramp up or stop in sync with GPU load. For those pairing it with an ROG Thor III or ROG Strix Platinum Series PSU, the card also supports voltage sensing for improved power stability. Power consumption remains standard at 360W TDP, with a 450 W PCIe Gen 5 connector, and Asus provides an adapter for three 8-pin connectors, ensuring compatibility with older power supplies. Display connectivity is slightly expanded compared to other RTX 5080s, with three DisplayPort 2.1b and two HDMI 2.1b ports, offering an extra output compared to most 5080s.

Software control is handled through Armoury Crate for system control, Aura Sync for managing RGB, and Asus GPU Tweak for overclocking – the latter being a comprehensive and well-featured tool that makes chasing higher performance easy. Asus backs the card with a standard three-year warranty.

SPECS 10,752 CUDA cores; 2,790MHz boost clock; 16GB GDDR7 30Gbps memory, 960GB/s memory bandwidth; 3x DisplayPort 2.1b, 2x HDMI 2.1b; 360W TDP; 3-year warranty.

VERDICT

★★★★☆

The Asus ROG Astral RTX 5080 OC Edition offers excellent performance and top-notch cooling, but it does command a higher price.
Lindsay Handmer

PRICE $2,599 **WEB** gigabyte.com

Gigabyte Aorus RTX 5080 Master

Unique, standout features and performance from a higher-end RTX 5080.

If you're after an RTX 5080 that offers factory-overclocked performance with a reasonable price tag, the Gigabyte Aorus RTX 5080 Master is worth considering. With an RRP of $2,599, it's positioned below some of the pricier models while still offering mighty cooling and a handful of extra features. At the time of writing, availability is limited, with no retailers listing it for preorder at RRP, and prices range from $2,399 up to $2,899.

Performance out of the box is well above stock, with the 2805MHz boost clock giving the Gigabyte 5080 around a 4% edge in games. Of course, for those who like to tweak their hardware, there's more on offer – pushing the card is easy, and it happily delivers a 10% improvement in frame rates with only a minor rise in temperature and no stability issues.

Cooling is handled by three 7-blade fans, each with winglets on the edges to improve airflow. Clamped to the circuit board beneath, a vapour chamber works alongside eight heat pipes to move heat away from the GPU core, as well as the RAM and voltage regulation system. The card includes a metal backplate for rigidity, with a large opening at the rear to improve airflow.

The Gigabyte 5080 includes a dual BIOS switch, allowing users to toggle between two preset modes. In Performance Mode, temperatures idle at 33°C with the fans remaining off, and peak at 63 °C under load, producing 33 dB of noise. Switching to Quiet Mode reduces fan noise to 31 dB under load, but temperatures rise slightly to 67 °C. The Gigabyte card also comes with an additional 120mm fan that can be attached to the rear heatsink vent and provide extra airflow – in our testing this dropped peak temps by only 1 °C, but it might be more useful in a hot case.

The Aorus RTX 5080 Master has a chunky, premium grey look (and is also available in white), with subtle RGB highlighting – including in the tips of the fans themselves. It also has a handy LCD on the top that can display GPU details like temp, or pics and animations of your choice. At 360 x 150 x 75 mm, the Aorus is a very large card, though it only weighs 2.032 kg – a comparative lightweight. Still, to help prevent sag, Gigabyte includes a reinforced backplate and a fully adjustable GPU support bracket. Unlike simpler stands that aren't secured in place, this one attaches directly to the GPU, providing a far more stable and adaptable setup.

Power requirements are standard, with a 360W TDP and a 450 W PCIe Gen 5 power connector. An adapter for three 8-pin connectors is included for those using older power supplies. The GPU also features a handy LED power indicator, making it easier to diagnose power-related issues at a glance.

For display output, Gigabyte sticks with the standard setup – three DisplayPort 2.1b and one HDMI 2.1b. Software support is provided through Gigabyte Control Center, which handles monitoring and tuning and is functional and straightforward to use. Warranty is a bit better than most competing cards, with registration extending the standard three-year coverage to four years.

SPECS 10,752 CUDA cores; 2,805MHz boost clock; 16GB GDDR7 30Gbps memory, 960GB/s memory bandwidth; 3x DisplayPort 2.1b, 1x HDMI 2.1b; 360W TDP; 3+1 year warranty.

VERDICT

★★★★½

The Gigabyte RTX 5080 Gaming OC delivers excellent performance and cooling at a fairly competitive price, and includes a bundle of handy extras.

Lindsay Handmer

apc
HIGHLY RECOMMENDED

PRICE $2,399 **WEB** msi.com

MSI RTX 5080 Suprim SOC

A premium but still not terribly priced RTX 5080 with a mighty cooler.

The MSI RTX 5080 16G Suprim SOC presents as a somewhat premium take on the Nvidia RTX 5080, offering a decent factory overclock, an impressive cooling system, and a few tasty extras. As far as overly expensive RTX 5080s go, it's competitively priced compared to more basic offerings, as well as OC models from other brands. At the time of writing, it's not actually in stock, but you can still preorder it for $2,399.

Out of the box, the card comes with a factory overclock, boosting to 2745MHz in gaming and silent modes, and 2760MHz in extreme performance mode. Read our benchmarks for the full story, but that translates to about a 2% performance boost over the standard Nvidia RTX 5080 – slightly less than expected. The Suprim does have further overclocking potential, and with a bit of tweaking, the card happily gave up to 10% extra performance versus a stock 5080, with only a mild increase in temperature and no stability issues.

This easy performance boost (without high temps) is possible because MSI has put a lot of extra effort into the card's cooling, with a triple-fan setup (each featuring seven blades), plus a vapour chamber and eleven heat pipes connected to a large heatsink. The card includes a chunky metal backplate for extra rigidity, but it has slots to improve airflow. MSI has also added thermal pads between the heat spreader and RAM and voltage regulation circuitry to help maintain temps. Overall, it's a well-built cooling system that is just as good as what's on the even more expensive 5080s.

MSI includes a dual BIOS switch, letting users choose between gaming and quiet modes. It's in game mode by default, and at idle, the card sits at 45 °C with the fans completely off. Under load, it maxes out at 58.9 °C, which is quite cool, though the memory is warmer at 74 °C. Noise levels are also excellent, and at full load, it hits 32 dB with very little coil whine – not quite silent, but not noisy enough to be heard outside a case. In quiet mode, it runs very slightly hotter at 59.2 °C but drops the noise to 30 dB.

Aesthetically, MSI has kept things pretty understated. The card is mostly grey, lots of angles and some understated RGB lighting to add a bit of flair. The Suprim is the largest of the 5080s tested, and measures in at a sizable 359 x 150 x 76 mm and weighs in at a hefty 2.68 kg. MSI includes a basic but easy-to-use support stand to help prevent sag, but be aware it's just held in place by the weight of the card, so it isn't suitable if you intend to take your PC on the road.

The card runs off a single 450 W PCIe Gen 5 connector, and MSI includes a 3x 8-pin adapter for compatibility with older power supplies. It uses the standard 360W TDP, so can be run from a modest 850W+ PSU. For driving your monitors, MSI sticks with the standard setup – three DisplayPort 2.1b outputs and one HDMI 2.1b port.

The included software package features MSI Center for monitoring and tweaking and the excellent Afterburner utility for overclocking. MSI also has an interesting bit of software called MSI App Player, which lets you run Android apps on your PC. MSI backs the card with a standard three-year warranty, which is pretty typical for a premium GPU from a good brand.

SPECS 10,752 CUDA cores; 2,745MHz boost clock; 16GB GDDR7 30Gbps memory, 960GB/s memory bandwidth; 3x DisplayPort 2.1b, 1x HDMI 2.1b; 360W TDP; 3-year warranty.

VERDICT

★★★★☆

The MSI RTX 5080 16G Suprim SOC is surprisingly cool and quiet, and while the factory OC is mild, it's easily pushed further.

Lindsay Handmer

BENCHMARK RESULTS	Asus ROG Astral RTX 5080 OC	MSI RTX 5080 Suprim SOC	Gigabyte Aorus RTX 5080 Master	Nvidia RTX 4090	Nvidia RTX 4080 Super	AMD RX 7900 XTX
SYNTHETIC BENCHMARKS						
3DMark Time Spy Extreme	16,841	16,201	16,035	19,145	14,423	15,598
3DMark Fire Strike Ultra	21,489	21,258	22,013	24,714	17,023	19,524
3DMark Steel Nomad	8,743	8,172	8,498	9,412	6,601	6,636
3DMark Speed Way	9,435	9,061	9,181	10,192	7,355	6,288
3DMark Port Royal	22,021	21,874	22,201	25,841	18,539	16,744
GAMING (AVERAGE FPS)						
NO RT OR UPSCALING, ULTRA DETAIL						
Cyberpunk 2077 - 1080p	149	142	146	155	99	112
Cyberpunk 2077 - 1440p	109	110	109	130	75	90
Cyberpunk 2077 - 4K	50	47	48	72	33	38
Cyberpunk 2077 - 4K DLSS 4	161	155	156	–	–	–
ULTRA RAY TRACING, BALANCED SCALING						
Cyberpunk 2077 - 1440p	105	101	102	83	63	43
Cyberpunk 2077 - 4K	67	65	71	41	33	22
Cyberpunk 2077 - 4K DLSS 4	204	201	218	–	–	–
ULTRA PATH TRACING, BALANCED SCALING						
Cyberpunk 2077 - 1440p	75	76	80	88	–	–
Cyberpunk 2077 - 4K	45	44	47	46	–	–
Cyberpunk 2077 - 4K DLSS 4	152	144	154	–	–	–
RAY TRACING, CINCEMATIC, 50% UPSCALING						
Black Myth: Wukong - 1080p	105	105	107	115	92	–
Black Myth: Wukong - 1440p	86	88	89	94	76	–
Black Myth: Wukong - 4K	55	55	56	62	47	–
F1 23 - 1080p	182	171	178	188	146	173
F1 23 - 1440p	144	148	149	156	136	151
F1 23 - 4K	96	101	95	112	82	99
Shadow of the Tomb Raider - 1080p	188	182	176	222	167	172
Shadow of the Tomb Raider - 1440p	170	166	169	201	135	142
Shadow of the Tomb Raider - 4K	144	136	159	183	118	129
Warhammer III - 1080p	209	217	202	224	203	225
Warhammer III - 1440p	95	91	96	124	99	107
Warhammer III - 4K	69	66	69	79	57	65
COMPUTE TESTING						
GeekBench 6 Compute (OpenGL)	275,612	265,983	269,390	321,655	271,145	207,950
GeekBench 6 Compute (Vulkan)	259,633	252,120	255,529	251,749	236,662	236,890
Blender (aggregate score)	3,001	2,915	2,980	3,291	2,691	1,363
THERMALS (°C) AND NOISE (DB)						
Peak GPU temp	67 °C	59 °C	63 °C	76 °C	64 °C	71 °C
Idle Temp	45 °C	38 °C	33 °C	38 °C	27 °C	28 °C
Peak sound level	38 dB	32 dB	33 dB	55 dB	59 dB	43 dB

Conclusion

In terms of raw performance, the 5080 is still bested by the last gen 4090, which averages around 20% better frame rates. But just as importantly, that comes at a 25% extra cost over the 5080, making the new card better value for money. Opting for the RTX 4080 Super ($1,800+) is 25% cheaper than the 5080, but around 28% slower overall. The AMD RX 7900 XTX is a wildcard – slightly cheaper than the 4080 Super, but performance that can be noticeable better in some games, but worse in most compute tasks.

With limited availability and high prices, the RTX 5080 doesn't offer a major improvement in bang for buck over previous-generation cards. Still, its new features and versatility make it a worthwhile upgrade for those who need such a powerful card. DLSS 4x frame generation is an interesting addition (though not yet well supported), but while it delivers impressively high frame rates, the actual gameplay only feels slightly smoother.

Across all three RTX 5080s tested, manual overclocking proved to be a key factor in achieving a noticeable frame rate improvement over stock speeds. Thanks to the large cooling systems, it's easy to get 10%+ performance over a stock card, which is worth the extra cost.

While all three cards tested were impressive, the Gigabyte Aorus RTX 5080 Master is the most compelling package, with a high but acceptable price, great cooler, loads of extras like the excellent GPU support strut, plus a four year warranty. ■

NEEDS Windows 7, 8.1. 10 or 11 **WEB** https://fotosketcher.com

FotoSketcher 3.97

Digital art tool.

Software that turns your photos into art by applying stylised effects is usually expensive, complicated or both. Although there are now AI tools that transform your pictures at the click of a button, they tend to be resource-intensive and limit the number or quality of images you can convert.

FotoSketcher avoids all these problems, offering a free, simple and unlimited way to make ordinary photos look like oil paintings, watercolours or pencil sketches. The program takes care of all the complex processing, letting you create stunning results with minimal effort.

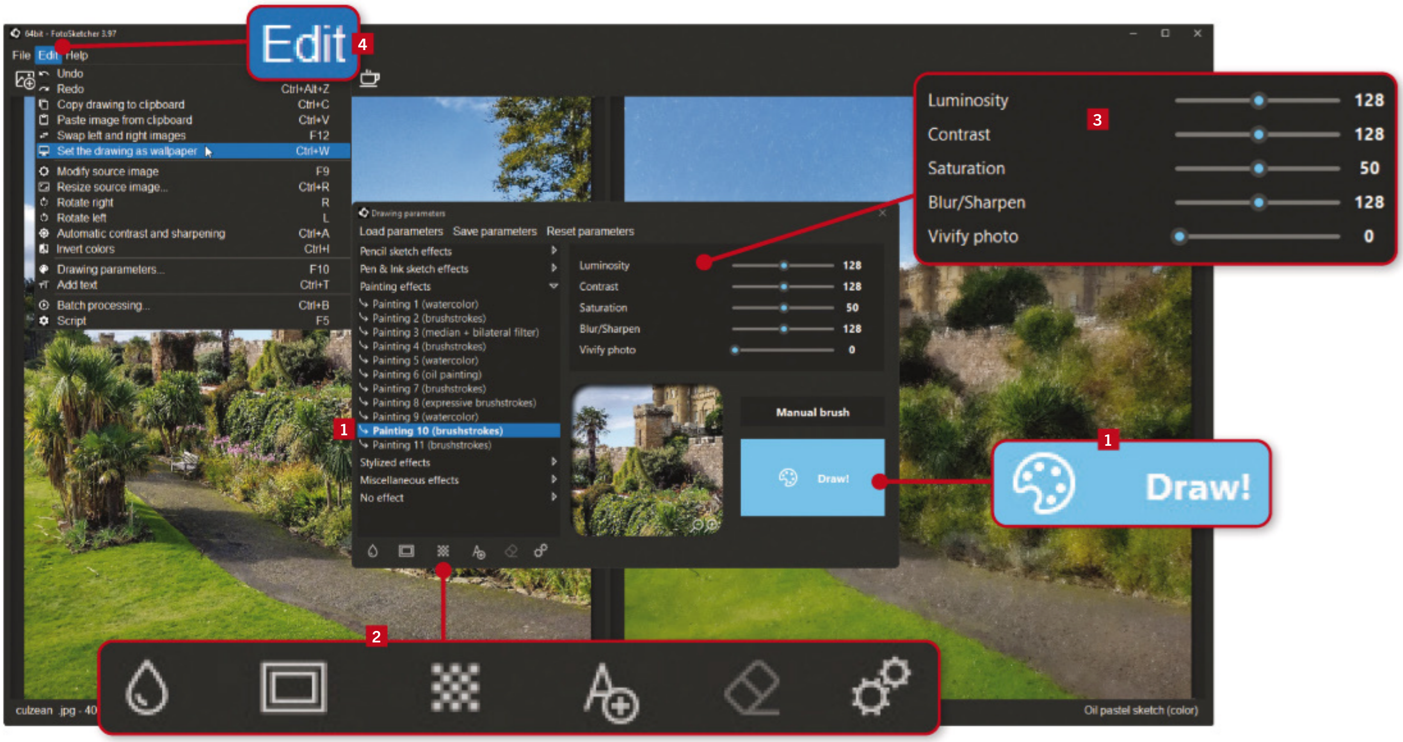
The FotoSketcher interface is split into two, with the left side showing your source image and the right offering a preview of the edited picture based on your chosen filters and effects. Click the ‘Drawing parameters’ (paint palette) button to choose from a wide range of pencil, paint and ink effects, as well as interesting options such as Cartoon and ‘Vintage photo’.

You can customise each effect to achieve the desired results – for example, by selecting the minimum size of brush strokes, the precision of oil pastels and the length of pencil lines. If you want to experiment, you can try using a manual brush to apply an effect to just a portion of your photo.

The latest version of FotoSketcher gives its layout a more modern feel and significantly improves its ‘No effect’ option. Previously, this simply copied the left-hand image to the right-hand side, so you could apply non-creative tweaks such as adding a frame, changing the canvas texture and inserting text.

Now it lets you modify the luminosity, contrast, colour saturation, sharpness and vividness of the source photo, as you can in a standard image editor. FotoSketcher has also fixed a bug that could cause it to crash when processing pictures.

When you install FotoSketcher, Microsoft Defender SmartScreen may show a security warning. The program is completely safe to use, so just click ‘More info’ then ‘Run anyway’.


64bit - FotoSketcher 3.97
File
Edit
Help
Edit
4
Undo
Redo Ctrl+Alt+Z
Copy drawing to clipboard Ctrl+C
Paste image from clipboard Ctrl+V
Swap left and right images F12
Set the drawing as wallpaper Ctrl+W
Modify source image F9
Resize source image... Ctrl+R
Rotate right R
Rotate left L
Automatic contrast and sharpening Ctrl+A
Invert colors Ctrl+I
Drawing parameters... F10
Add text Ctrl+T
Batch processing... Ctrl+B
Script F5
Drawing parameters
Load parameters
Save parameters
Reset parameters
Pencil sketch effects
Pen & Ink sketch effects
Painting effects
Painting 1 (watercolor)
Painting 2 (brushstrokes)
Painting 3 (median + bilateral filter)
Painting 4 (brushstrokes)
Painting 5 (watercolor)
Painting 6 (oil painting)
Painting 7 (brushstrokes)
Painting 8 (expressive brushstrokes)
Painting 9 (watercolor)
1
Painting 10 (brushstrokes)
Painting 11 (brushstrokes)
Stylized effects
Miscellaneous effects
No effect
Luminosity 128
Contrast 128
Saturation 50
Blur/Sharpen 128
Vivify photo 0
Manual brush
Draw!
3
Luminosity 128
Contrast 128
Saturation 50
Blur/Sharpen 128
Vivify photo 0
1
Draw!
2
culzean .jpg - 40
Oil pastel sketch (color)

1 The ‘Drawing parameters’ panel is the most important feature in FotoSketcher, giving you access to all its effects. Select one in the list on the left to see a preview of how it will look, then click the Draw button to apply it to your photo.

2 The options in the bottom-left corner of the panel let you add a frame to your photo (choose a size, style and colour) and adjust the canvas texture. You can also add text such as your name, a caption or a copyright notice.

3 FotoSketcher 3.97 expands the ‘No effect’ option to let you fine-tune your photos without applying effects. Use the sliders to adjust the luminosity, contrast and colour saturation; blur or sharpen the image; and make it more vivid.

4 Further options in the Edit menu include rotating photos, swapping the left and right images and applying automatic contrast and sharpening. FotoSketcher also lets you set pictures as desktop wallpaper.

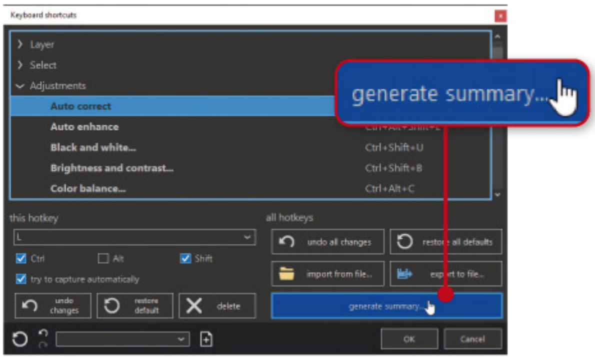
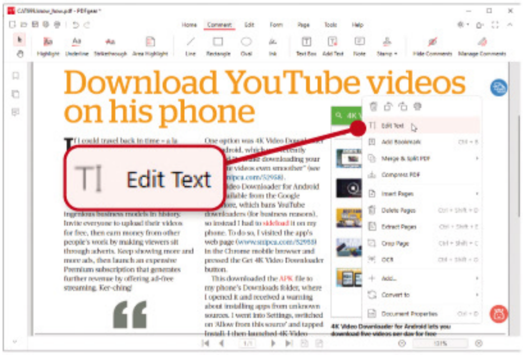

Keyboard shortcuts
Layer
Select
Adjustments
Auto correct
Auto enhance
Black and white...
Brightness and contrast...
Color balance...
generate summary...
undo all changes
restore all defaults
import from file...
export to file...
delete
OK
Cancel

IMAGE EDITOR

PhotoDemon 24.12

WEB https://photodemon.org **NEEDS** Windows 7, 8.1. 10 or 11

The latest update to this excellent free image editor adds a couple of features that make it even more versatile and easy to use. One is the ability to open and save images in the HEIC and HEIF formats used by iPhones and some DSLR cameras. The other lets you create custom keyboard shortcuts for actions you perform frequently. Click the Tools menu and choose ‘Keyboard shortcuts’ to open the full list of commands, which are organised by menu – such as File, Edit, Adjustments and Effects. Assign hotkeys to items in bold by pressing the keyboard shortcuts you want to use. PhotoDemon will tell you if that hotkey is already assigned to another action. Click ‘generate summary’ (see screenshot) to save an HTML file of your hotkey collection. Click ‘More info’ then ‘Run anyway’ if you get a SmartScreen warning during installation.


Download YouTube videos on his phone
Edit Text
Add Bookmark
Merge & Split PDF
Compress PDF
Insert Pages
Delete Pages
Extract Pages
Crop Page
OCR
Convert to
Document Properties

PDF EDITOR

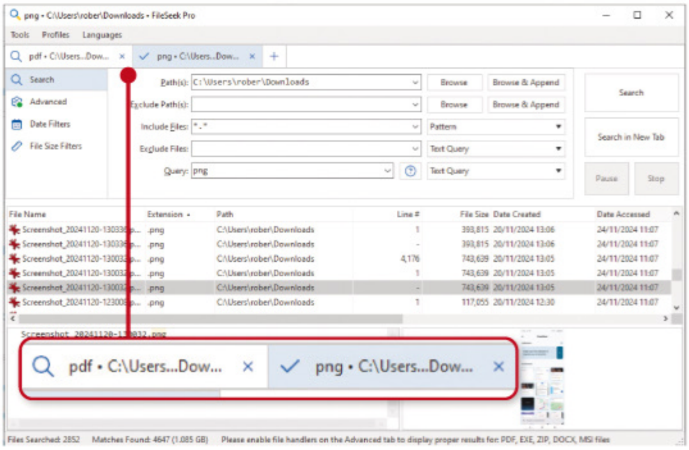
PDFgear 2.1.10

WEB www.pdfgear.com **NEEDS** Windows 10 or 11, or macOS

PDFgear was one of your favourite programs of 2024 and managed to squeeze in another update just before the year ended. To “streamline workflow”, it has finally introduced support for keyboard shortcuts, so you can perform common actions much faster. Unlike PhotoDemon (see above), you can’t customise these hotkeys, but you can see the full list by clicking the Help tab then Settings and selecting Shortcuts. Just as useful is the new right-click menu for PDFs, which gives you instant access to options such as Edit Text (see screenshot), Merge & Split PDF, Delete Pages, OCR and ‘Convert to’. PDFgear has also improved its dark mode and added ‘tooltips’ to menu buttons, which explain their function when you hover your cursor over them and give you their keyboard shortcut where available.

Should I pay for?

Choose the right version of software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Tools
Profiles
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Path(s):
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Search in New Tab
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Stop
pdf • C:\Users...Dow...
png • C:\Users...Dow...

FileSeek Pro

WEB www.fileseek.ca **PRICE** US$19 **FREE TRIAL** 30 days **NEEDS** Windows 10 or 11

We’re always on the lookout for alternatives to the unreliable file-search tool built into Windows, and FileSeek is a worthy contender. It has lots of useful options to help you find files quickly, and it doesn’t slow your PC by ‘indexing’ in the background.

The Pro edition has a generous free trial that lets you test all FileSeek’s features for a month before it reverts to the Free version. Unlike many freemium tools, it doesn’t nag you to upgrade and there are only a few differences between editions.

Both versions allow you to search any folder or drive, with options to search only for items created or modified within a specific time frame, set minimum and maximum file sizes and look inside text files as well as their names.

FileSeek’s searches are impressively fast and thorough. You can filter its detailed results by criteria including extension, size and date, and it provides previews for image files. We particularly like the way you can integrate the program with File Explorer’s right-click menu, so you can search folders without launching FileSeek first.

The Pro version includes the useful option to open searches in multiple tabs (see screenshot), which is probably the only feature you’ll miss when your trial ends. It also lets you export search results as an HTML or CSV file, and save your search settings as a profile.

OUR VERDICT: DON’T PAY FOR IT

Other than tabbed searches, the free version of FileSeek offers everything you need to find files quickly across your PC. The Pro edition doesn’t give you much more for your money, though in fairness it’s relatively inexpensive. ■

> “FileSeek’s searches are impressively fast and thorough. You can filter its detailed results by criteria including extension, size and date, and it provides previews for image files.”

PRICE Free (offers IAPs) **NEEDS** iOS 18 or later **WEB** themitycompany.com

Stuff | ToDos and Lists

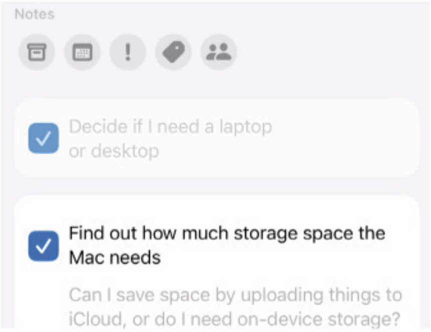
Know your when and where stuff.

Stuff is an app built to organise all the, well, stuff in your life using reminders and to-do lists. Yet while its pleasing design belies an impressive level of functionality, it's not a must-buy app yet.

Stuff is designed around simplicity, with a layout that's clean and attractive with bold fonts and bright colours. Adding new entries is quick and easy – just tap the '+' button in the bottom-right corner to create a task, list or space (the latter groups both tasks and lists into one section). Stuff is full of other neat touches, with haptics and animations put to good use throughout.

Yet you shouldn't mistake Stuff's simplicity for a lack of features. We like how it uses both deadlines and planned dates: a planned date is when you want to carry out the task, which can be sooner or later than its deadline. That means you can use Stuff as a schedule for your work assignments. You can also set the deadline to 'someday', giving you more flexibility.

Dependencies are another selling point. If a task is dependent on another, you won't be able to complete it until the original task has been done. That lets you create lists of cascading tasks that unlock one after the other, and it's a nifty way to link sequential tasks into a flow-chart like system.



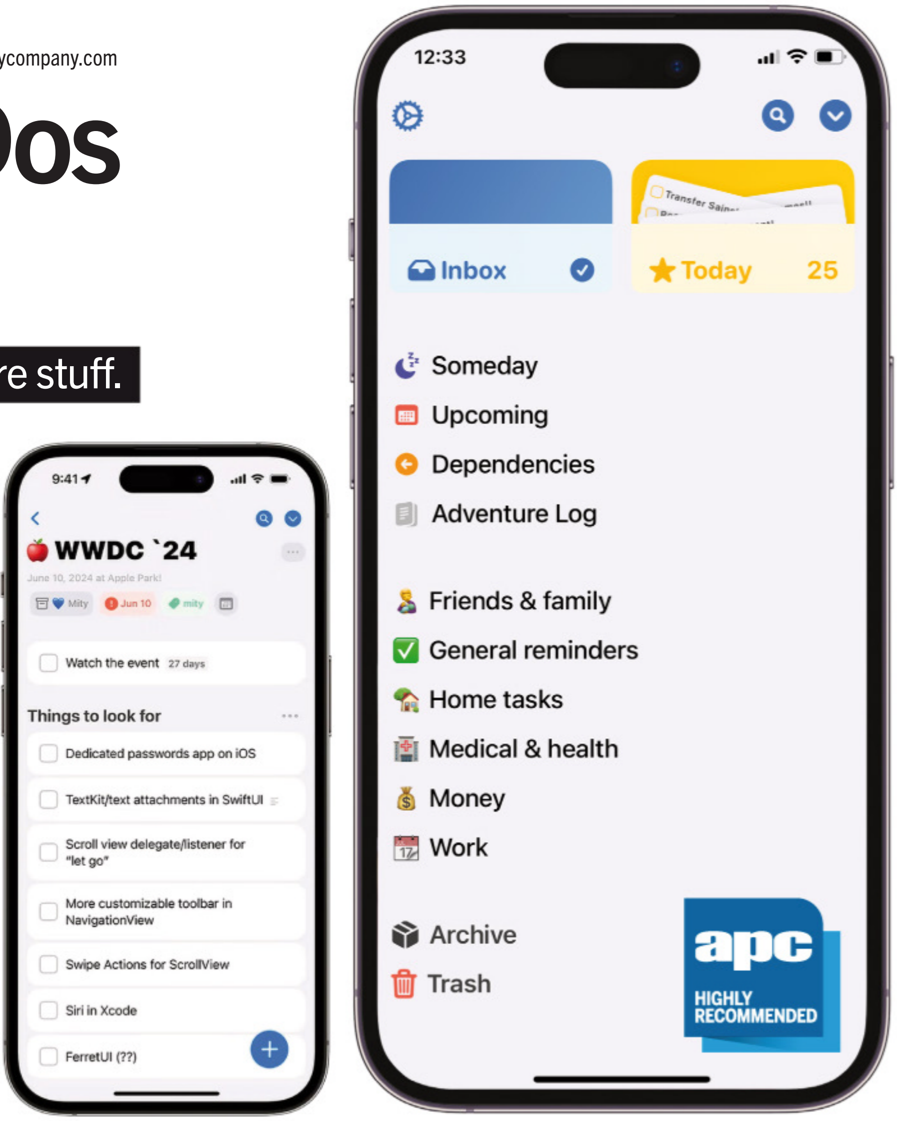
Notes

☑ Decide if I need a laptop or desktop

☑ Find out how much storage space the Mac needs

Can I save space by uploading things to iCloud, or do I need on-device storage?

Tapping a task reveals deadlines, notes, tags and more.



9:41

WWDC `24

June 10, 2024 at Apple Park!

Mity · Jun 10 · mity

☐ Watch the event 27 days

Things to look for

☐ Dedicated passwords app on iOS

☐ TextKit/text attachments in SwiftUI

☐ Scroll view delegate/listener for "let go"

☐ More customizable toolbar in NavigationView

☐ Swipe Actions for ScrollView

☐ Siri in Xcode

☐ FerretUI (??)

12:33

Inbox

Today 25

Someday

Upcoming

Dependencies

Adventure Log

Friends & family

General reminders

Home tasks

Medical & health

Money

Work

Archive

Trash

Stuff's clean home screen makes it easy to dive in.

Diving into a list lets you see all due tasks for that list, even far into the future. Grouping tasks around sections rather than a calendar (more on that later) also means you can use Stuff as a makeshift shopping list or checklist, which saves you having to use multiple apps.

You can tap a task to see extra info and notes, but we dislike how deadlines are hidden until tasks are expanded. The app treats overdue items as being due today, which can clog up your Today list and – since Stuff prioritises planned dates over deadlines – you can't see how far overdue a task is without expanding it.

Elsewhere, in smart lists that contain tasks pulled from other sections (like Upcoming or Someday), list tags are shown in grey. Giving them each a colour would make differentiating tasks easier. We lament the lack of a proper calendar, too. While Stuff integrates with Apple's Calendar app, it only shows events in a thin row at the top of the Today and Upcoming lists – there's no full-scale calendar option, which is missed in a reminders and tasks app.

Despite this, Stuff is off to a good start. We appreciate its commitment to clean design, its interesting ideas, and the ease with which you can get started. If it can correct a few important missteps, it'll be a strong contender for your iPhone's Home Screen. ■

> "Stuff is full of neat touches, with haptics and animations put to good use throughout."

VERDICT

★★★★☆

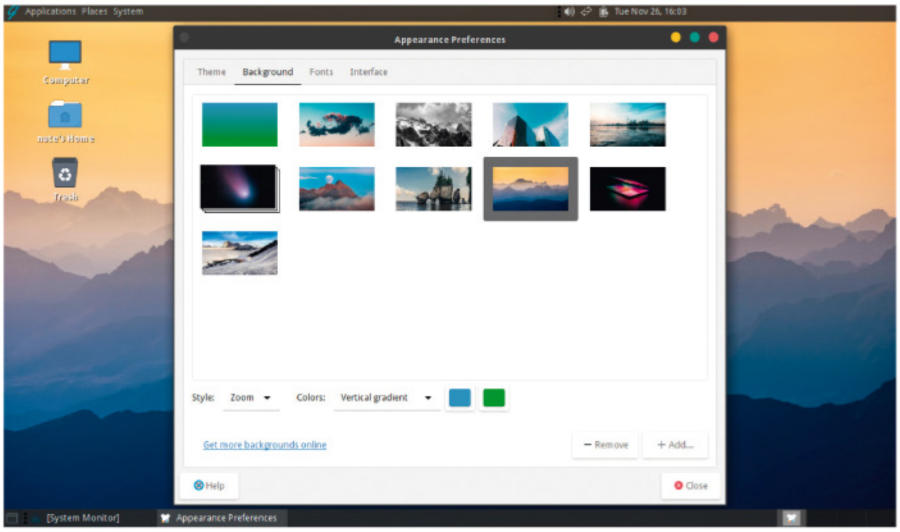
A promising to-do list app with lots of clever concepts, but there's room to improve.

Alex Blake

DEVELOPER Eric Turgeon and GhostBSD Team **WEB** www.ghostbsd.org **LICENCE** FreeBSD

GhostBSD 24.10.1

Nate Drake determines whether this is the Casper of the BSD world or whether your system will be haunted by bugs.



Style: Zoom
Colors: Vertical gradient

The default edition of GhostBSD uses MATE, so you can customize appearance settings like the system wallpaper and Vimix theme.

As fans of both Linux and open source, we keep a weather eye on developments in the BSD camp. GhostBSD was first released in 2010, presenting itself as a more user-friendly alternative to FreeBSD, on which it's based.

The official ISO is 2.6GB and uses the MATE desktop, though there's also a community image running Xfce. Whichever version you choose, downloads are available both via BitTorrent and directly from the website.

After firing up the MATE version we were slightly puzzled by the notification that GhostBSD intended to 'Replicate [the] system image to swap-based memdisk'. After reviewing the download page, we realised this is because when the OS boots, it loads directly into virtual memory. This is also why you need to have at least 4GB of RAM.

Upon booting to the live environment, we noticed our VM display resolution was stuck stubbornly at 1,024x768. This gave us a chance to visit GhostBSD's excellent user forums, where a kind poster explained how to increase video memory to fix this.

With the monitor just so, we launched the setup assistant. This was extremely intuitive, prompting us to select the language, keyboard, time zone and disks. However, while custom partitioning is supported, there's no option for full disk encryption. This has come up in the forums, as this feature is available in FreeBSD. The lack of inclusion also seems at odds with the claim in the installer's elegant splash screen that every OS should be 'secure and protect your privacy'.

Upon reboot, we fired up the MATE menu and browsed through GhostBSD's pre-installed apps. As we did this, we found a peculiar bug when clicking on the Applications menu with our trackpad, as it seemed to disappear again immediately afterwards.

We also noticed a quirk with keyboard entry, as we entered our password quickly, only for letters to be repeated. This was made particularly difficult, as there's no way to unhide the characters as they're entered. When we slowed our inhuman typing speed to that of ordinary mortals, however, the system accepted our password. We put this down to running GhostBSD in a VM, so encourage you to do your own research.

Once we mastered the Applications menu, we fired up the system monitor to confirm that at rest the distro uses less than 500MB of RAM, though 4GB is required to run the system in the first place. The distro also used less than 3% of our virtual CPU resources. MATE's Disk Usage Analyzer also informed us that GhostBSD has a very light install footprint of 3.6GB.

Using the MATE version of GhostBSD means the desktop appearance is highly customisable. You can switch between light and dark versions of the default Vimix theme. If the mountainous default background isn't to your taste, there are 10 alternative wallpapers. You can make use of Control Center to set preferred applications, such as the web browser. The handful of pre-installed apps are well curated, including Firefox, VLC, Rhythmbox and the gloriously colourful Fish terminal utility. Further packages can be installed via GhostBSD's Software Station. Upon launch, it informs users that it's syncing, which in our case took around two minutes.

BSD users will know that the selection of packages isn't as great as in most versions of Linux. Still, the latest GhostBSD contains important upgrades, including a fix to allow streaming of Netflix shows on Chromium. There's also enhanced support for AMD Radeon and FirePro graphics cards. ■

> "The handful of pre-installed apps are well curated, including Firefox, VLC, Rhythmbox and the gloriously colourful Fish terminal utility."

VERDICT

★★★½☆

GhostBSD is definitely easier to set up and use than FreeBSD but we encountered minor bugs when testing it out.

Nate Drake

BEST LAPTOPS OF CES 2025

PLUS 44 OTHER RELEASES

We pick the 56 standout products and new technologies from this year's CES.

A DEEP DIVE INTO THE CLIMATE PHENOMENON
THE MONSOON
Best of
CES
2025!

Every year, CES acts as a calling card for all the great new technology due to be released in the coming year. It's the only place to be if you want to see what companies will be pinning their hopes on. You'll bump into everyone from PhD students with ideas fresh from research labs to directors of global tech firms. And CEOs, too, with Nvidia's Jensen Huang stealing much of the limelight, as we describe opposite.

CES takes place in Las Vegas, consuming two huge convention centres and speckling its way across many of Sin City's hotels. With the first briefings taking place on a Sunday and the show closing the following Friday, even with the assistance of our colleagues at Future Publishing – including brands such as *Laptop Magazine*, *LiveScience*, *TechRadar*, *Tom's Guide* and *Tom's Hardware* – it's a week-long battle to uncover the brilliant. And some that's just plain weird, as you'll discover if you turn to our segment on robots.

We dedicate 13 pages of this month's magazine to the show, and frankly you should see our discard pile. There are countless laptops, PCs, monitors and gizmos that failed to make the cut, with our aim being to give you the best possible taste (to misquote Kenny) of what CES offers.

CONTRIBUTORS Barry Collins, Tim Danton and Jon Honeyball, plus Keumars Afifi-Sabet, Paul Alcorn, Jason England, John Loeffler, Hassam Nasir, David Nield and Anthony Spadafora

INDIANA JONES AND THE GREAT CIRCLE
GEFORCE RTX

NVIDIA AT CES 2025

Jensen Huang's keynote at CES 2025 didn't disappoint, but it was only when we saw live demos using the new Nvidia cards that we appreciated what the company had achieved.

Nvidia's RTX 50-series GPUs were arguably the biggest news of CES 2025, encompassing four desktop cards – the RTX 5090, RTX 5080, RTX 5070 Ti and RTX 5070) – plus equivalent chips for laptops. But to get a true taste for what the cards could do, I went behind the scenes at a private Nvidia event.

DLSS 4 IS THE KEY

"Can it run *Cyberpunk 2077*?" has become the 2020s equivalent of "can it run *Crysis*?", and boy, can the RTX 5090 run *Cyberpunk 2077*. At maxed-out settings, I saw a peak of around 265fps and a low of 245fps. Every detail is crisp, the fidelity incredible and smoothness fantastic – and much is thanks to Deep Learning Super Sampling (DLSS) 4. This uses a machine learning model trained on the game to boost resolution and improve frame rates.

Nvidia's secret sauce is changing from a convolutional neural network (CNN) to a transformer model. A CNN relies on the layers it sees before it, which can result in ghosting (seeing the outline of a fast-moving item on screen follow behind it). A transformer model is similar to the LLMs powering ChatGPT and Google Gemini and, according to Nvidia, this "enables self-attention operations to evaluate the relative importance of each pixel across the entire frame and over multiple frames". In other words, this new version of DLSS can think a few steps ahead. The end result is far better frame rates and image quality. And this isn't hype.

The Super Resolution and Ray Reconstruction transformer models give the tiniest of details a real sense of existence in-game worlds. On top of that, the new transformer model is 40% faster and uses 30% less video memory. There is a tiny amount of latency, but nothing compared to previous generations. DLSS 4 features are coming to older GPUs too, but none will take advantage quite like the 50 series.

4090 PERFORMANCE IN RTX 5070?

My eyes lit up when Jensen claimed you're going to get the performance of the RTX 4090 in the RTX 5070, but surely that's too good to be true? Sort of. It comes down to the Multi Frame Generation aspect of DLSS that is exclusive to RTX 50-series cards. With DLSS 4 on the 50-series, the transformer model isn't limited to generating one additional frame, but can now generate three.

For comparison, Nvidia booted up *Marvel Rivals*. With an RTX 4090 generating one additional frame, you're seeing around 180fps; on a 5070, that goes up to nearly 250fps on the same settings. In other games, the two GPUs are more equal in terms of frames, with Nvidia picking *Marvel Rivals* for the demo due to it being exceedingly strong in frame generation.

And there's the twist. Jensen's claim depends on developers supporting Multi Frame Generation. If the game doesn't support it, then the RTX 4090 is still going to be better.

LEFT Find out what Project DIGITS is on p61.

RTX IS GOING NEXT-LEVEL ON AI

Nvidia is going hard on the word "neural" with the RTX 50-series, and for good reason. For me, RTX Neural materials was the first standout feature when looking at the demos in person. Typically, game developers must bake in the texture of an object or surface and the rules of how it interacts with the rest of the world's lighting and ambiance. With RTX Neural materials, AI compresses that code and makes processing up to 5x faster. The end result is that multi-layered items such as silk look dramatically more realistic, with subtle colour changes that follow light diffraction.

Then there's RTX Mega Geometry, which massively increases the amount of triangles that build everything you see in a game for insane levels of granular detail. Typically, more detail means more VRAM, as this stores essential graphical instructions in the background that the game will need to constantly refer back to. These could be anything from textures to lighting, facial expressions to animations.

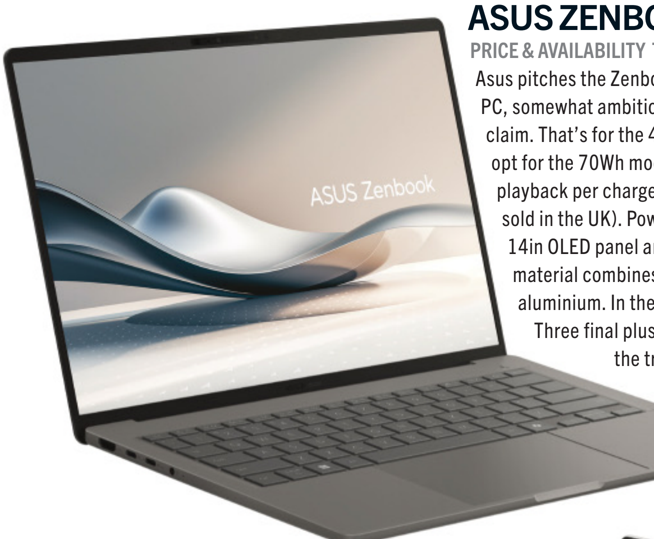
The RTX 50 series' onboard AI means textures can be compressed to save up to seven times of that previous video memory, while the Neural Materials feature works in tandem to process materials up to five times faster. Some key textures in the demo Nvidia showed me dropped from 47MB to 16MB. That's a huge reduction that also frees up the memory needed for Mega Geometry.

OUTLOOK

Nvidia deserves all its headlines. Games of today can render faster, look sharper and run smoother. Games of the future could be packed with so much detail it would take you pressing your face on the screen to actually find the pixels. **JASON ENGLAND**

BEST LAPTOPS

With new silicon from AMD, Intel and Nvidia, CES 2025 saw an unprecedented number of stylish and powerful new laptops. Here's our roundup of the best debuts.



ASUS ZENBOOK A14

PRICE & AVAILABILITY To be confirmed

Asus pitches the Zenbook A14 as the world's lightest Copilot+ PC, somewhat ambitiously describing it as "light as air" in one claim. That's for the 48Wh version, which weighs 899g, but I'd opt for the 70Wh model as that promises 32 hours of video playback per charge (thankfully, this is the model that will be sold in the UK). Powered by Snapdragon X chips, it packs a 14in OLED panel and Wi-Fi 7, while Asus' "Ceraluminum" material combines the feel of ceramic with the lightness of aluminium. In the flesh, it looks genuinely lovely, too.

Three final plus points: the keyboard is nice and crisp, the trackpad is large, and you still benefit from USB-A and HDMI, along with two USB-C ports.

TIM DANTON

HP ELITEBOOK X G1I 14IN

PRICE TBC, AVAILABLE From February 2025

HP's refreshed EliteBook range is rather tame compared to the HP ZBook Ultra G1a 14 opposite, but this sleek 1.4kg laptop will appeal to business buyers. HP is pushing its AI features – it meets Microsoft's Copilot+ PC criteria – and don't dismiss them as I expect HP's AI Companion app to turn into a handy helper over the years. The 14in, 120Hz, 2,560 x 1,600 touchscreen covers 100% of the DCI-P3 and Adobe RGB gamuts, HP claims, with Intel's Core Ultra 200V chips inside. Also look out for the "Ultra" version, which will come with a choice of Intel and Qualcomm chips and replaces the Dragonfly series.

TIM DANTON

LENOVO THINKPAD X9

PRICE AND AVAILABILITY To be confirmed

Prepare to be shocked: this new ThinkPad series doesn't include a TrackPoint. And – gasp! – it's finished in dark grey rather than trademark black. It's all part of Lenovo's attempt to attract a younger breed of buyers to its most famous business brand, and if you think the picture above resembles a MacBook that's one reason why. It also enables Lenovo to include a haptic touchpad, while a spokesperson told me that studies show more people prefer the X9's scissor-style keys than the traditional ThinkPad action (I'm not one of them).

The other big innovation is a discrete "hub" on the chassis bottom with dual fans to keep the Core Ultra 200V vPro chips running at their peak. This allows Lenovo to keep the rest of the chassis as thin as 6.7mm.

The X9 will come in 14in and 15.3in versions, with respective weights of 1.2kg and 1.45kg. Either way, your eyes will thank you for a 2,880 x 1,800 resolution, OLED technology and 120Hz refresh rates. The final plus: a 5MP webcam with a two-micron sensor, well suited to video capture in low light.

TIM DANTON

apc
BEST OF CES 2025
ASUS EXPERTBOOK
ASUS EXPERTBOOK

ASUS EXPERTBOOK B5

PRICE & AVAILABILITY To be confirmed

I've long been impressed by the build quality and value of Asus' ExpertBook range. I don't yet have a price, so can't talk about the latter when it comes to its new flagship business laptop, but the sturdy all-aluminium chassis (I'm told it's resilient to 1.2m drops along with passing all the usual MIL-STD-810H tests) makes me confident it will last for years of abuse.

Asus also talks a good game for sustainability, with a battery that can be replaced without tools, while a unique QR code reveals each laptop's carbon footprint. Based around Intel's Core Ultra 200V vPro chips (*see p33*), and with a 63Wh battery, it will easily last a full day of work, and there's plenty here for IT directors, too: ExpertGuardian to protect against cyber attacks, extra BIOS protection and Windows 11 Secured-core PC technologies to name but three.

Perhaps most importantly, end users will enjoy typing on the firm keyboard and gazing at the 14in 144Hz OLED screen (an option, so we'll see if that hits the UK). Choose the Core 9 Ultra version with 64GB RAM and a 2TB SSD – there's a second M.2 slot, too – and you have one compelling system for even your most demanding users. TIM DANTON

HP ZBOOK ULTRA G1A 14

PRICE To be confirmed ● AVAILABLE Autumn 2025

Yes please. That was my simple reaction to seeing the ZBook Ultra G1a 14 in the flesh at CES, because this self-proclaimed mobile workstation doesn't weigh the typical 2-3kg of most yet still packs the power required to tackle hefty tasks such as CAD. That's all due to AMD's all-new Ryzen AI Max Pro processors, which support up to 128GB of unified memory, which is a fancy way of saying that up to 96GB of RAM can be dedicated to the integrated AMD Radeon graphics. HP also reckons the Ryzen AI technology can "redefine workflows", but that very much depends on software vendors taking advantage of the 50 TOPS NPU.

There isn't space inside this slender chassis for discrete graphics, so some tasks will be best left to bulkier workstations, but HP claims up to 14 hours of battery life depending on usage and which screen you choose. These range from a Full HD IPS touchscreen panel to a choice of two QHD OLED panels, and no doubt adding these will also bulk up the price – a subject on which HP remains quiet.

With Wi-Fi 7, up to 4TB of storage and a decent selection of ports (one USB-A, two Thunderbolt 4, one USB-C 3.2 Gen 2 and HDMI 2.1) and a stylish dark grey design, it's hard not to be wowed by what HP has done here. Especially when you consider it weighs 1.5kg. TIM DANTON

apc
BEST OF CES 2025

LENOVO YOGA SLIM 9I (14IN, GEN 10)

PRICE & AVAILABILITY To be confirmed

If you love phones that include an all-round glass finish then take note of the new 1.2kg Yoga Slim 9i, designed to catch the light like jewellery. Lenovo assured me it won't break, unless you count onlookers' hearts. It also features a 32MP camera mounted behind the screen, which means that when you're on video calls you won't have that faraway gaze. Everything else is typical of Lenovo's top-end consumer laptops, including 1.5mm key travel, a 4K 120Hz OLED panel and kick-arse speakers. It also ticks the Copilot+ PC box with Core Ultra 200V chips. **TIM DANTON**

SAMSUNG GALAXY BOOK5 PRO 5

PRICE & AVAILABILITY To be confirmed

Samsung announced the global release of its Book5 Pro and Book5 Pro 360 at CES 2025, so I visited its stand to take a look. And, well, it's fine. Sleek, silver and sexy, like all previous Galaxy Books. The key upgrade is the switch to Intel's Core Ultra 200V Series chips, which should solve one of my biggest criticisms of predecessors – their battery life. Samsung's 25-hour claims for the 16in Pro are perhaps a tad ambitious, bearing in mind this is a high-resolution AMOLED panel, so I'll be interested to put the laptops through their paces if and when Samsung sends me review samples later this year. TIM DANTON

ACER ASPIRE VERO 16

PRICE TBC ●

AVAILABLE Q2 2025

It's great to see Acer expanding its sustainability-focused Vero line, this time updating the chassis of its 16in laptop to be smoother and a shade more stylish as a result. It features Intel's new Core Ultra 200H Series processors, and with up to 99 TOPS there's plenty of local AI power. That sadly means the memory – up to 32GB – can't be replaced, but the SSD can, and overall this laptop has been designed for easy repair. There's no getting away from the fact that the most sustainable laptop is the one you already own, but if you're looking to invest in a "green" laptop that will last for years then this is a top choice. TIM DANTON

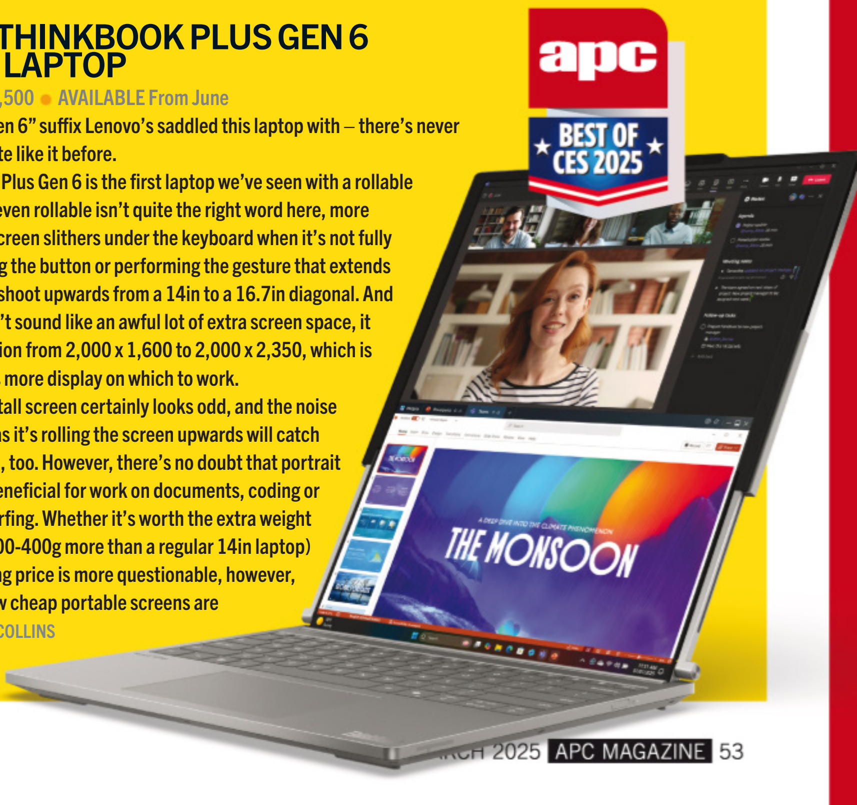
LENOVO THINKBOOK PLUS GEN 6 ROLLING LAPTOP

PRICE From US$3,500 ● AVAILABLE From June

Ignore the silly "Gen 6" suffix Lenovo's saddled this laptop with – there's never been anything quite like it before.

The ThinkBook Plus Gen 6 is the first laptop we've seen with a rollable screen. Although even rollable isn't quite the right word here, more slideable, as the screen slithers under the keyboard when it's not fully extended. Pressing the button or performing the gesture that extends the screen sees it shoot upwards from a 14in to a 16.7in diagonal. And though that doesn't sound like an awful lot of extra screen space, it boosts the resolution from 2,000 x 1,600 to 2,000 x 2,350, which is getting on for 50% more display on which to work.

That extended tall screen certainly looks odd, and the noise the motor makes as it's rolling the screen upwards will catch people's attention, too. However, there's no doubt that portrait format could be beneficial for work on documents, coding or even basic web surfing. Whether it's worth the extra weight (1.7kg is a good 300-400g more than a regular 14in laptop) or US$3,500 asking price is more questionable, however, not least given how cheap portable screens are becoming. BARRY COLLINS



apc
BEST OF CES 2025

RAZER BLADE 16

PRICE To be confirmed ● AVAILABLE Q1 2025

The days of gaming laptops that are thicker than the Yellow Pages (teenagers, ask your parents) are numbered. The new Blade 16 is almost physically identical to a 16in MacBook Pro, so slender that it's hard to fathom that Nvidia's top-of-the-range RTX 5090 GPU is tucked somewhere inside this thing.

The Blade 16 is the very opposite of a gaudy gaming laptop. It's demure black metal casing wouldn't look out of place on an office desk, which is handy for professionals who require the graphics grunt. How well that slender casing copes with cooling will have to wait for the review, however, as the graphics chip alone can demand 155W.

The QHD+ OLED display is a stunner, with a 240Hz refresh rate and a response time of 0.2ms. Its factory-calibrated colour profiles for Adobe RGB, DCI-P3 and Rec. 709 are more good news for those thinking of excuses to buy this beyond gaming.

Intel's been thrown overboard for this 2025 model, with up to an AMD Ryzen AI 9 HX 370 inside, along with up to 64GB of non-replaceable 8,000MHz LPDDR5X RAM. It will come in various configurations, none of which will please the Money Saving Expert.

BARRY COLLINS

ACER SWIFT GO 14/16 AI

Go 14: PRICE TBC ● AVAILABLE Q2 2025 | Go 16: PRICE TBC ● AVAILABLE Q2 2025

Following the hot trend for laptops at CES, the Go 14 and Go 16 both include punchy OLED panels. They will come in a variety of resolutions, but from what I saw at the Acer stand you can expect excellent colours and rich blacks. No shock there. Nor is there in the sleek chassis, with the 16in version weighing 1.5kg with a promise of up to 22 hours' battery life and the 14in Go dropping to 1.3kg but upping life expectancy to 27 hours. This makes the smaller version more attractive, especially as both pack Intel's Core Ultra 200H Series chips, Wi-Fi 7, two Thunderbolt 4 ports and a promising-sounding 1440p webcam. TIM DANTON

MSI STEALTH 18 HX AI

PRICE To be confirmed ●
AVAILABLE Spring 2025

We could have included countless gaming laptops released at CES 2025 (Acer, Asus, Dell and Lenovo all released multiple models), but I single out the MSI Stealth 18 HX AI due to its focus on creators as much as gamers. Nvidia's latest GPU arguably offers as much of an upgrade for video editors and designers as it does for gamers, and the Stealth 18 HX AI supports the top-end RTX 5090. You also benefit from an 18in mini-LED display in a 2.9kg frame – lightweight considering what's within, which includes your choice of the new AMD Ryzen AI Max or Core Ultra 200HX CPUs . Cracking speakers complete the package.

TIM DANTON

DELL'S NEW STRATEGY AND LAPTOPS

Farewell old friends. I refer, of course, to Dell's XPS, Inspiron, Latitude and Precision brands, which have been sacrificed on the Apple-esque altar of simplicity. Now you have to pick between Dell, Dell Pro and Dell Pro Max ranges, each with the choice of Base, Plus and Premium options. So perhaps not quite Apple-esque simplicity.

So, what does it actually mean? Plain Dell, equivalent to ye olde Inspiron, is for value buyers. Unless you choose Dell Premium, which is basically the XPS range. Dell Pro is basically a rebadged Latitude range, so you get more manageability features for business rollouts. And Dell Pro Max is the new name for workstation-class products, previously known as Dell Precision.

RIGHT The new Dell 14 Plus, formerly Inspiron Plus.

RIGHT Dell's Pro Premium range replaces its high-end Latitude.

Aggravatingly, Dell wasn't at CES, so I couldn't get my hands on the nine models it announced. Dell's first releases are all from the Pro range, with the Dell Pro 13 Premium, the Dell Pro 14 Plus, the Dell Pro 14 Premium and the Dell Pro 16 Plus. It's no coincidence that all four use Intel's new Core Ultra 200V Series with vPro (*see p33*). They all meet Microsoft's Copilot+ PC criteria, too.

Of all the new laptops, the Pro Premium models look the most interesting. These include modular ports for easier repair (inspired, Dell says, by its Project Luna environmental initiative), while the tandem OLED available on the 14in model is, to quote Dell's Sam Burd, "nearly 25% more power efficient, 12% thinner and almost 50% lighter than a traditional OLED".

Dell says it will release the full range of new laptops over the coming months, so I look forward to getting them in for review.

Now that Dell has committed to this new branding strategy – which extends across all its hardware, including monitors – I can't see it backing down. Personally, though, I find it odd to abandon the years of equity and trust that Dell has built up via its XPS branding in particular, even accepting the argument that this new structure makes it easier for people unfamiliar with Dell's historic products to pick what's right for them. TIM DANTON

BEST MINI PCs

GEEKOM QS1 PRO

PRICE & AVAILABILITY To be confirmed

It should be no surprise that a mini PC specialist is among the first to sell a system based around Qualcomm's Snapdragon platform, in this case the 12-core X1E-80-100. All the usual caveats apply about performance – blistering in multitasking, not so great at 3D acceleration – but with a 45 TOPS NPU for local AI tasks I'd be happy with this as my main system. It resembles the Geekom A6, but note the four microphone slots and that there's space for two M.2 SSDs. It also comes with Windows 11 Pro, a three-year warranty and dual 2.5GbE ports. All we need now is a price and on-sale date. TIM DANTON

apc ★ BEST OF CES 2025 ★

ACER REVO BOX AI

PRICE TBC ● AVAILABLE Q2 2025

If you needed any more indication that mini PCs are the hottest of hot potatoes, welcome to the Revo Box AI. Acer has sold compact PCs before, for business use, but this is its first mainstream offering to match the likes of Geekom and Minisforum. It measures 0.75 litres, weighs around 500g and includes a Core Ultra 200V processor, so meets the Copilot+ PC spec. You can add up to 32GB of RAM and 1TB of storage, while the dual 2.5GbE ports add welcome flexibility. And unlike most mini PCs, Acer is also including a wireless keyboard and mouse in the package. TIM DANTON

HP Z2 MINI G1A

PRICE To be confirmed ● AVAILABLE Spring 2025

While I love the HP ZBook Ultra G1a 14, if you're after even more power you should turn to its mini PC sibling, the glorious HP Z2 Mini G1a. The "a" stands for AMD, as it includes the Ryzen AI Max Pro. That means up to 16 cores and 32 threads for smooth running, and if you specify its maximum 128GB of RAM then 96GB can be dedicated to graphics.

Other neat tricks include an integrated PSU – much neater than an external block – and two "Flex IO" ports, along with all the connectivity you'd hope for. For demanding users, perhaps wanting to run local LLMs, it's a great choice. TIM DANTON

LENOVO THINKCENTRE NEO 50Q

PRICE TBC ● AVAILABLE February 2025

Lenovo is the first big-name manufacturer to create a mini PC based around the new Snapdragon X chip (*see p32*), and interestingly it's targeting businesses with this 1.2-litre box. There's room for two M.2 SSDs inside, while numerous office-friendly ports sit at the rear: DisplayPort, HDMI, four USB-A and a gigabit Ethernet port. A further USB-A port sits alongside a USB-C connector at the front (plus a 3.5mm combo jack). In the flesh it's not what I'd call a looker, but its sleek dimensions mean it should fit into most spaces – or behind a monitor. TIM DANTON

MINISFORUM A1 X1 PRO MINI PC

PRICE & AVAILABILITY To be confirmed

I'm very much hoping that I can persuade Minisforum to send the A1 X1 Pro in for review when it eventually lands, as on paper it looks like a cracking mini PC. Based around AMD's Ryzen AI 9 HX 370 CPU, part of the new Ryzen 300 Series, it includes an NPU rated at 50 TOPS, supports up to 96GB of memory, and you can add up to 12TB of storage via three M.2 slots. And an OCuLink port sits ready for an external GPU should AMD's Radeon 890M graphics prove too weak for you. We await further details such as price or a release date. TIM DANTON

MSI CUBI NUC AI+ 2M

PRICE & AVAILABILITY To be confirmed

It may not look like a business PC, but that's the target MSI has in mind with its Cubi NUC mini PCs (so far, at least), with the NUC AI+ 2M offering much to entice IT teams looking to simplify their setups. This 0.83-litre system is VESA mountable, includes Intel's Core Ultra 200V chips (up to the 258V), and at the rear you'll find a pair of 2.5GbE ports along with two Thunderbolt 4 ports. One of these supports power delivery up to 100W, and if you buy an MSI monitor you can even switch the Cubi on via its power switch. There's also a built-in mic and speaker to make video calls simpler. TIM DANTON

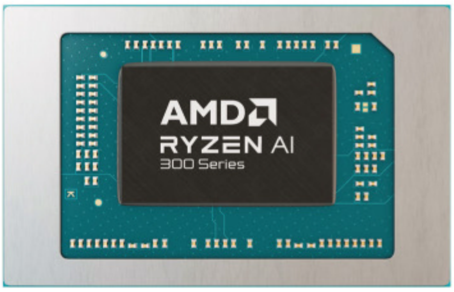
GEEKOM A6

PRICE TBC ● AVAILABLE TBC

When I met with Geekom representatives at CES, they had one thing on their mind: the A6. Designed to offer great value from the off – though the Australian price is yet to be announced, you get a powerful Ryzen 7 6800H CPU, 32GB of DDR5 RAM, a 1TB SSD and Windows 11 Pro. The 6800H is a couple of years old now, so doesn't include Ryzen AI, but with eight performance cores and 16 threads it will easily cope with everyday demands for years to come. With a three-year warranty and Geekom's usual sturdy magnesium alloy chassis, this is a mini PC for bargain hunters. TIM DANTON

BEST CPUs

Both AMD and Intel revealed a host of new processors at CES, with Qualcomm not to be left behind with its Snapdragon X chips.



AMD RYZEN 200 AND AI 300

PRICE Not applicable ● AVAILABLE Q1-Q2 2025

Alongside its powerful Ryzen AI Max and 9000H/HX CPUs, AMD launched two mainstream mobile CPUs at CES: the Ryzen 200 and AI 300 Series.

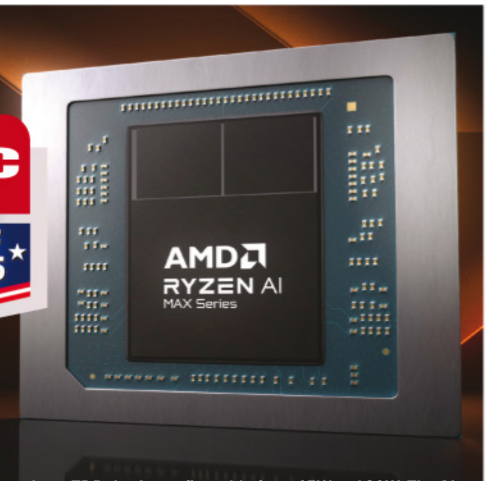
The budget 200 series is an update to the Ryzen 8040 series. It lacks the AI moniker as – at best – it includes an NPU rated at 16 TOPS. These chips are based on AMD's Zen 4 architecture, using a mix of Zen 4 and Zen 4c (so more efficient) cores. The Ryzen 3 210 sits at the bottom with four cores, eight threads and no NPU, while the Ryzen 9 270 tops the list with eight cores, 16 threads and the NPU.

The Ryzen AI 300 series is more interesting, based on Zen 5 architecture (using a mix of Zen 5 and Zen 5c cores) and wielding a 50 TOPS NPU to meet the Copilot+ PC threshold. AMD reckons the Ryzen AI 7 360 offers the fastest multitasking in its class, being 30% than the Qualcomm X Plus X1P-42-100 and 54% faster than Intel's Core Ultra 7 258V in Cinebench R24. The Ryzen AI 7 350 (eight cores, 16 threads) and Ryzen AI 5 350 (six cores, 12 threads) will be available in Q1.

Most of the Ryzen 200 and Ryzen AI 300 series will also be made available in Pro versions, which hints at the growing importance of commercial laptops in AMD's strategy. HASSAM NASIR

AMD RYZEN AI MAX/ MAX PRO

apc BEST OF CES 2025

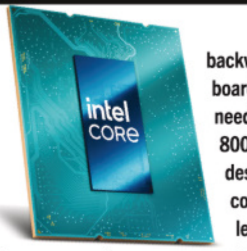


PRICE Not applicable ● AVAILABLE Q1-Q2 2025

AMD has created a monster with its "Strix Halo" Ryzen AI Max series of laptop processors. Designed for thin-and-light gaming and AI workstation laptops, and featuring what AMD bills as the fastest integrated graphics in the Windows ecosystem, the flagship Ryzen AI Max+ 395 features 16 CPU cores, 32 threads and 40 RDNA 3.5 graphics cores, with support for up to 128GB of shared memory. AMD claims this architecture allows for up to 1.4 times faster gaming performance than Intel's flagship Core Ultra 9 288V and up to 84% faster rendering performance than the Apple MacBook M4 Pro. Additionally, says AMD, the AI Max+ 395 delivers up to 2.2 times more performance in AI workloads than the Nvidia RTX 4090 GPU, all with an 87% lower TDP.

The series includes four SKUs, all featuring a 55W base TDP that's configurable from 45W to 120W. The AI Max 390 includes 12 CPU cores and 40 graphics cores, the 385 packs 12 CPU and 32 graphics cores, while the AI Max 380 Pro includes six CPU cores and 16 graphics cores. The "Pro" indicates that it supports AMD's Ryzen Pro technologies, described opposite. Now we must hope AMD delivers. PAUL ALCORN

INTEL CORE ULTRA 200S



PRICE Not applicable ● AVAILABLE Now

Is it just me, or is it getting harder to understand Intel's naming strategy? Buried among its announcements at CES was an extension to its Core Ultra 200S Series desktop chips, all of which are non-K models (so they can't be overclocked). For example, there's the Core Ultra 9 285 rather than the Ultra 9 285K. Muddying the waters is that some of the new chips are "Bartlett Lake-S", which are backwards-compatible with Intel's LGA 1700 boards, while others are "Arrow Lake-S", which need the newer LGA1851 socket and an 800-series chipset. The new chips are designed to be more affordable than their "K" counterparts, while still delivering the high levels of performance that demanding users would expect – including AI workloads. Just note that the NPUs aren't powerful enough to meet Copilot+ PC requirements. The Arrow Lake-S chips are already available, with the Bartlett Lake-S variants due to follow later this year. TIM DANTON

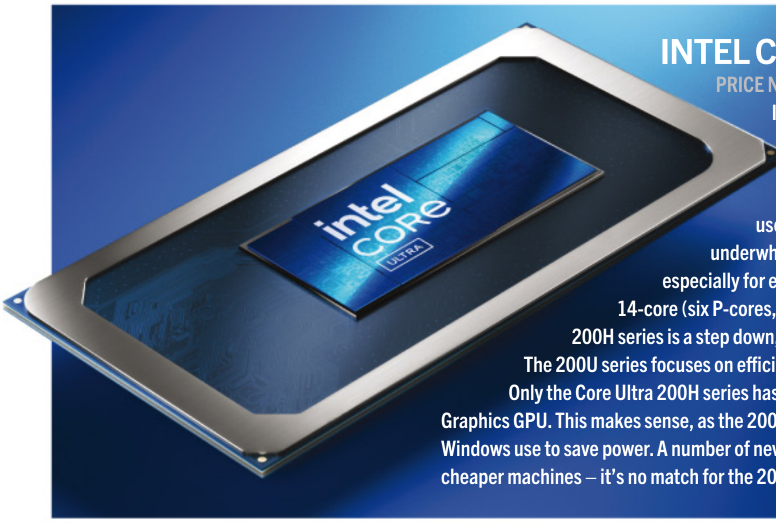
QUALCOMM SNAPDRAGON X

PRICE Not applicable ● AVAILABLE Now

When I dropped in to see Qualcomm at CES, it was keen to point out that every single one of its Snapdragon X processors includes the same NPU. So, as a buyer, you know that you can take advantage of its AI abilities, whether that's mixing music or accelerating previously tough workloads such as background removal in photos (and they were impressive demos). This is in contrast to AMD and Intel, where you have to be very careful when selecting which chip you buy as many – including the new arrivals at CES – include NPUs that don't meet Microsoft's 40 TOPS criterion for Copilot+ PCs.

Naturally, Qualcomm's all-new Snapdragon X platform does, with the same 45 TOPS. Although calling it a platform right now feels over the top, as it consists of a single chip, the X1-26-100. This includes eight cores running at a peak of 3GHz, with a 30MB cache and an Adreno GPU rated at 1.7 TFLOPS. That compares to 12 cores, 4GHz, 42MB and 4.6 TFLOPS for its popular X1E-80-100 Elite chip, which reflects the fact that Qualcomm is targeting budget buyers who want Copilot+ PCs with its new chip. And not just laptops, with a handful of mini PCs also featuring the X1-26-100. TIM DANTON

Snapdragon
X



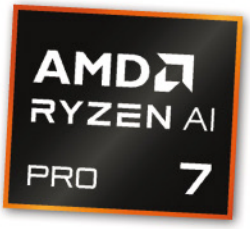
INTEL CORE ULTRA 200H, 200HX AND 200U

PRICE Not applicable ● **AVAILABLE** Now

Intel announced its latest series of mobile processors at CES 2025, with the Ultra 200HX family targeting enthusiasts, Ultra 200H aimed at premium users and Ultra 200U meant for thin and light laptops. Unlike the 200V family, which use Lunar Lake architecture, the new chips are built off the same Arrow Lake architecture used in the current Core Ultra 200S desktop CPUs. Arrow Lake for desktop was rather underwhelming for gamers, but it makes sense for laptops due to its relative power efficiency, especially for everyday and professional workloads. The 200HX series covers six CPUs, from the 14-core (six P-cores, eight E-cores) Core Ultra 5 235HX to the 24-core (8P/16E) Core Ultra 9 285HX. The 200H series is a step down, ranging from the 12-core (4P/8E) Ultra 5 225H to the 14-core (6P/8E) Ultra 9 258H. The 200U series focuses on efficiency, with two P-cores and eight E-cores throughout the range. Only the Core Ultra 200H series has Intel's top-end Arc graphics, with the HX and U series including the basic Intel Graphics GPU. This makes sense, as the 200HX series will likely be paired with a discrete GPU, leaving the integrated GPU for basic Windows use to save power. A number of new laptops include the H and HX series chips, but the 200U is likely to be found in cheaper machines – it's no match for the 200V series. JOHN LOEFFLER

AMD RYZEN PRO

PRICE Not applicable ● **AVAILABLE** Now



One of Intel's biggest strongholds against AMD and Qualcomm is on commercial PCs, in part because of its long history in the sector but also due to the adoption of vPro – although AMD's general manager of its client business unit, Rahul Tikoo, told me at CES that he reckons only 5-10% of businesses actually activate the vPro technology they've invested in.

AMD launched its own out-of-band management system, Ryzen Pro, back in 2017, but it gained fresh momentum this year with almost all of its new mobile chips being launched with Ryzen Pro variants. "Intel has put a great marketing machinery around vPro and how important vPro is, but the reality is that Ryzen Pro does that and more," Tikoo said during our interview. "And companies can do exactly what they want to do in manageability or security or deployment of their products [with AMD] they can do with the other side." It's surely no coincidence that Dell's new fleet of commercial laptops support AMD for the first time. TIM DANTON

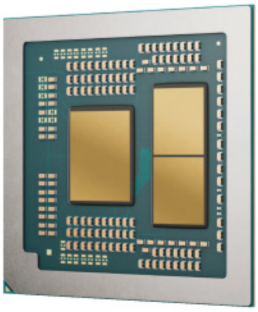
AMD RYZEN 9000HX

PRICE Not applicable ● **AVAILABLE** H1 2025

"For the ultimate mobile gaming experience, new AMD Ryzen 9000HX Series processors deliver the most incredible performance a gaming laptop has ever seen." So gushed AMD's press release announcing its new graphics and gaming products at CES, and you can see why it's so bullish when you realise that its top release includes the V-Cache memory technology that many games love.

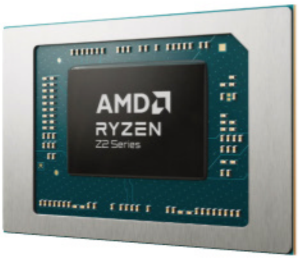
There are three chips in the range, but it's only the Ryzen 9 9955HX3D that includes this extra cache, bringing its total to 144MB. It also packs a handy 16 cores (32 threads), with a boost frequency of up to 5.4GHz. The Ryzen 9 9955HX has the same specs but only 80MB of cache, while the Ryzen 9 9850HX includes 12 cores, 24 threads, 76MB cache and boosts up 5.2GHz. Both will be great candidates for creator laptops, too.

The 9000HX range is based on Zen 5 cores, with a dual chiplet design, but there's no NPU. TIM DANTON



AMD RYZEN Z2

PRICE Not applicable ● **AVAILABLE** Q1 2025



AMD's Ryzen Z2 series is helping to usher in the second generation of PC gaming handhelds in 2025, with the promise of a step up in performance and efficiency compared to the Z1 series.

The Ryzen Z2 chips come in three tiers: Z2 Extreme, plain Z2 and Z2 Go. The Z2 Extreme features eight cores and 16 threads, a 5GHz boost clock, 24MB cache, 16 RDNA 3.5 GPU cores and a 15W-35W power envelope. The Z2 also features eight cores and 16 threads, but with a slightly higher 5.1GHz boost clock, the same 24MB cache, but 12 RDNA 3.5 GPU cores rather than 16, and a smaller 15W-30W power envelope. The all-new Ryzen Z2 Go (there's no equivalent in the Ryzen Z1 series) packs four cores and eight threads, a 4.3GHz boost clock and 10MB cache, but the same 12 GPU cores and 15W-30W power envelope as the Ryzen Z2. There's no hard release date as that depends on the handhelds, as detailed overleaf. JOHN LOEFFLER

intel
CORE
ULTRA

INTEL CORE ULTRA 200V WITH VPRO

PRICE Not applicable ● **AVAILABLE** Now

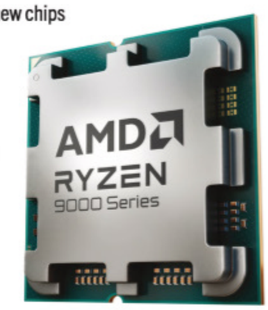
Intel's Core Ultra 200V ("Lunar Lake") series was the company's biggest silicon hit of 2024, and it doubled down on the technology by announcing vPro versions of the processors at CES. You only need to read through our list of best laptops to see how eagerly this move has been embraced by commercial laptop makers, and little wonder as the 200V series provides Qualcomm-rivalling battery life coupled with great performance – except in multitasking benchmarks. They meet Microsoft's 40 TOPS criterion for Copilot+ PCs, too. Intel also announced that it was making it far simpler for businesses (of all sizes) to roll out vPro technologies. Which makes sense, as vPro makes it possible to manage PCs and laptops remotely, which would have been a great help during the CrowdStrike fiasco last year. TIM DANTON

AMD RYZEN 9 9900X3D AND 9950X3D

PRICE & AVAILABILITY To be confirmed

AMD is finally replacing the Ryzen 9 7950X3D and Ryzen 9 7900X3D processors released in early 2023, while also offering a step up from the existing 8-core 9800X3D. The 9900X3D features 12 cores, a 5.5GHz Boost clock and a 140MB L3 cache on a 120W TDP, while the 9950X3D packs 16 cores, a 5.7GHz Boost clock and a massive 144MB L3 cache on a meatier 170W TDP.

Unlike the 9800X3D, the new chips aren't strictly designed for gamers. The 9950X3D, especially, is being pushed as a creative processor on a par with the Core Ultra 9 285K and Core i9-14900K. Whether the new chips strike the right balance remains to be seen, but AMD is making promising claims. JOHN LOEFFLER



BEST HANDHELDS

NVIDIA GEFORCE NOW ON STEAM DECK

PRICE Free ● AVAILABLE Soon

If you own a Steam Deck, you probably already know you can apply a workaround to get GeForce Now on the handheld. Soon there will be no need for this fiddly hack, as official support is on its way.

Perhaps the biggest benefit won't be felt by those who primarily use the device for handheld gaming, but by those docking their Steam Deck with a full-blown display: you'll now be able to stream 4K at up to 60 frames per second using the Deck, provided you've got one of the punchily priced Ultimate tier accounts. The benefits will presumably extend to the SteamOS version of the Lenovo Legion Go (*see right*) and future SteamOS devices, too. BARRY COLLINS

Lenovo
LEGION

LENOVO LEGION GO S

PRICE SteamOS TBC, Windows 11 $1,299 ● AVAILABLE SteamOS May 2025, Windows 11 Q1

The Lenovo Legion Go S is the first of what's expected to be several third-party devices to license SteamOS, the Linux-based operating system Valve uses on its enormously popular Steam Deck handhelds.

There's a Windows 11 version too, which feels a bit like a sop to keep Microsoft sweet, although Lenovo appears to be making a pointed remark with its pricing. The base SteamOS version will be around $200 cheaper than its Windows 11 equivalent, because the Windows version requires a bigger battery.

If your interests are purely gaming, there's little reason not to go for the SteamOS version. The selection of games isn't as broad, but most titles are compatible, and in our experience the lightweight, handheld-oriented OS is better for mobile devices than full-blown Windows. Its colour scheme is nicer too, in dark purple compared to the pure white Windows version.

The Go S has an 8in LCD display (sadly, not OLED) with a 1,920 x 1,200 resolution. It comes with up to an AMD Ryzen Z1 Extreme processor and Radeon 700M series graphics, and up to 32GB of RAM. If you can't wait to get your hands on one, there's a $1,299 Windows version on sale now, with a Ryzen Z2 Go. BARRY COLLINS

RAZER KISHI + PC REMOTE PLAY

PRICE Free beta ● AVAILABLE Now

Razer's Kishi controllers do a very presentable job of turning your smartphone into a gaming device, particularly if you use streaming services such as GeForce Now or Xbox streaming. Now Razer has hit on the idea of reviving in-home streaming, with the release of free software that lets you stream games from PC to phone across your home network, or even the open internet if you're brave enough.

Razer is positioning this software as an accompaniment to its latest controller, the Kishi Ultra, although it works with any Kishi or indeed any controller/phone combo. The company claims it's made it easier to launch games than rival apps, and that it auto-matches the phone's resolution on the PC, avoiding ugly black bars on the phone screen. BARRY COLLINS

THE WITCHER

ACER NITRO BLAZE 11

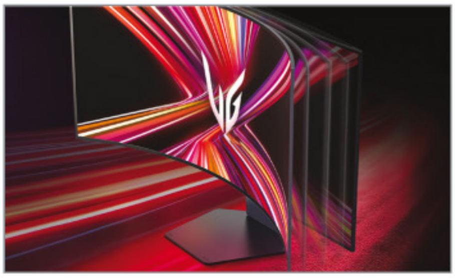
PRICE TBC ● AVAILABLE Q2 2025

It's hard to describe just how massive the Acer Nitro Blaze 11 feels in the hand – it's not dissimilar to holding a dinner tray, albeit a very expensive one with cracking graphics.

Well, we say cracking graphics. The spoilsports on Acer's CES stand didn't actually let us play games on the pre-production model that was on display at the show in case we wrote disparaging things about it, but the spec suggests this Windows-based handheld should deliver a decent wallop of gaming power. Its AMD Ryzen 7 8840HS processor, coupled with Radeon 780M graphics, shouldn't disappoint. It will come with up to 2TB of storage, although the 16GB of RAM is a touch on the tight side.

The controllers on each side of the display are detachable, but given how much room there is to play with on them, it's disappointing that Acer didn't see fit to include a touchpad for navigating the OS as well as gaming. Windows 11 has never been a pleasure to navigate with touch alone, even bearing in mind Microsoft's promise to redevelop the UI for gaming handhelds. That extra screen space will certainly make it more pleasurable to play games with a cramped UI that are a struggle on regular handhelds, although Acer has an 8.8in version as well if you find the digital dinner tray too cumbersome. BARRY COLLINS

BEST DISPLAYS



LG ULTRAGEAR OLED 45GX990A

PRICE & AVAILABILITY To be confirmed

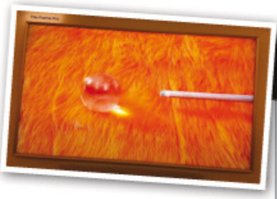
The display industry can't make its mind up whether curved or flat screens are in fashion, so why should you? The LG UltraGear OLED 45GX990A offers both: at the press of a button on its remote control it goes from flat to a 900R curved screen.

It isn't short of resolution, with 5,120 x 2,160 pixels spread across the 45in OLED panel. The LG Dual-Mode technology means it can switch between native 21:9 and 16:9 aspect ratios, with picture sizes of 27in, 34in or 39in.

It supports DisplayPort 2.1, HDMI 2.1 and USB-C with 90W power delivery, and is certified for Nvidia G-Sync and AMD FreeSync to keep everything looking smooth. A non-bendy version is launching at US$1,999, so expect this to cruise past the US$2,000 mark when it arrives later this year. BARRY COLLINS

SAMSUNG THE FRAME PRO

PRICE & AVAILABILITY To be confirmed



Samsung's The Frame concept is to give your TV a purpose in life beyond Netflix and the like, namely by displaying works of art. The Frame Pro ups the ante by introducing Mini LED technology to the range, giving the device stronger picture quality all round.

Samsung has worked hard on the aesthetics by making the controller box wireless, meaning you only need worry about keeping the power cord out of sight now. That controller box can be placed up to 10m away, Samsung claims, even with obstacles in its path.

The Frame Pro certainly looked punchy on Samsung's CES mega-stand; we'd expect the price to be equally eye-popping when it's finally launched. BARRY COLLINS

POCKETBOOK INKPOSTER

PRICE TBC ● AVAILABLE To be confirmed

If the idea of leaving a TV on to display wall art, like Samsung's The Frame, leaves you fearing for the polar bears (and so it should), the PocketBook InkPoster is a much more palatable alternative.

It needs to be charged only once a year, because this E Ink display – available in three sizes – displays art using the same sort of technology as your Kindle, needing no power to retain its image, only to refresh.

The colours and resolution of the images looked awesome on the CES showfloor, as good as high-quality prints, with the obvious advantage that the art can be refreshed. The 13.3in version will cost around $1,200, there's also a 31.5in model and 28.5in version, which has a different screen technology from Sharp. BARRY COLLINS

HP OMEN 32X

PRICE TBC ●

AVAILABLE April

The HP Omen 32x isn't just a gaming monitor as it packs Google TV. When you're not playing games, you can fire up Google TV and unwind with a selection of TV shows. No matter what's on the screen, everything looks gorgeous thanks to the sharp 4K resolution and smooth 144Hz refresh rate. It can even stream directly from four platforms, such as YouTube, if you want to show off your gameplay to others. You can do Android casting right from your phone, and deploy DeX Mode to get some work done. It looks to be a relatively affordable gaming monitor that can serve multiple purposes. BARRY COLLINS

BEST ALL-IN-ONE PCs

HP OMNISTUDIO X NEXT-GEN AI PC

PRICE TBA ● AVAILABLE Soon

What's most striking about the OmniStudio X is that it actually looks like a monitor rather than an all-in-one. Indeed, it can act as a monitor if you connect a laptop or PC. But its real skill is as an AI PC, based as it is around Intel's Core Ultra 200V processors, with support for up to 32GB of RAM and 2TB of storage. I was a little saddened to see that HP had abandoned the movable camera of its previous high-end all-in-one PC, but at the expected relatively low price I'm willing to concede the point. TIM DANTON

ACER ASPIRE S AI

PRICE TBC ● AVAILABLE Q2 2025

Acer launched two all-in-one PC ranges at CES: the C series, with a fixed stand, and the S series, shown here, which is finished in white and is a shade more expensive. Both are available in 24in and 27in variants and both meet Copilot+ PC requirements, with the S series using Intel's Core 200V chips and the C series relying on AMD's new Ryzen AI 300 chips. What marks the S series out is its touchscreen, along with support for Wi-Fi 7. HP wins the award for its greater versatility and (in my view) style, but it's a close-run battle. TIM DANTON

BEST ROBOTS

We think humanoid robots will be huge (well, about 5ft 8in) in 2025, but what we saw at CES 2025 was a mix of the fluffy, fearsome and worrying.

ADAM

PRICE Price varies ● AVAILABLE Available to rent in the US now

The robotic bartender ADAM uses AI to mix the perfect drink, say scientists at Richtech Robotics (**richtechrobotics.com**). It can be configured to make hot drinks like coffee and bubble tea, too, with an extensive library of drinks stored in its software. It also interacts with customers – according to company representatives – and provides recommendations. You can even rent ADAM… but right now, it's only available in the USA. KEUMARS AFIFI-SABET

REALBOTIX ARIA

PRICE $175,000 ● AVAILABLE Now

"Let's get down to brass tacks," I say to Realbotix's CEO, on the company's tiny CES stand. "Is this a sex doll?"

"No," Andrew Kiguel replied, "but it can have, what I would say, conversations of a more intimate nature."

The conversation I'd want to have with Aria is: why do you cost so much? This $175,000 premium model, the apparent epitome of the company's goal to "create robots that are indistinguishable from humans", looks about as **lifelike as Nelson's Column. Her limbs move** like C-3PO having a stroke, her lips are badly out of sync with her speech, she moves around on a massive Roomba-like plinth. Even Captcha wouldn't bother asking Aria to prove she was human – she has less charm than a wheelie bin. Even calling Aria "she" is an offence against pronouns.

Still, if you get sick of looking at "her", you can rip her magnetic face off and replace it with another, maybe even one that looks like a celebrity or a historical figure. Don't ask how much that costs. Don't ask anything further. Just don't. BARRY COLLINS

BALLIE

PRICE To be confirmed ● AVAILABLE Q2 2025

It's hard to believe that Ballie – the concept AI-powered robot that resembles a *Star Wars* droid – is already five years old. But the bright yellow, rolling smart home companion is finally getting released commercially this year, Samsung representatives announced during a press conference at CES. Responding to "Hey, Ballie", the robot comes with plenty of sensors, a projector and AI designed to help you complete daily tasks, such as giving you directions. It also has a 2K camera on its rear and a 4K camera on the front. KEUMARS AFIFI-SABET

HAGAMOSPHERE

PRICE & AVAILABILITY Prototype only

Sitting on the line between drone and robot, the ominous-sounding (and looking) HAGAMOSphere packs eight propellers into a compact cubic frame and mounts them in a spherical chassis. This means the drone not only flies horizontally and vertically in any direction, but can also roll and rotate on the ground. Its Japanese creators (**hagamosphere.com**) hope to see it deployed in disaster-recovery scenarios in the future, including search and rescue due to its ability to dart into small gaps. KEUMARS AFIFI-SABET

MI-MO

PRICE $3,000 (mini), $30,000 (full-size) ● AVAILABLE Late 2025

Disney lawyers may be in touch with Japanese developer Jizai (**jizai.ai**) after CES, with this Pixar-like lamp drawing crowds for its sheer cuteness. Jizai doesn't intend to sell this exact model, instead viewing itself as a hardware platform provider – it will release an SDK later this year and make Mi-Mo available for sale to developers. It's then up to third-party companies to create their own robots using its AI solution. Mi-Mo is there to give them hardware to play with right away, whether that's the full-size Mi-Mo on a multi-legged table or the mini version. TIM DANTON

MIRUMI

PRICE Around $140 ● AVAILABLE Mid-2025

This adorable (or slightly unsettling) miniature robot clings onto your bag and interacts with people around you. Mirumi resembles a sloth and uses a built-in measurement unit and distance sensor to detect nearby people and then interacts with them by blinking its googly eyes and rotating its head. The somewhat less fluffy-sounding Yukai Engineering (**ux-xu.com**) said Murumi will be made available via a crowdfunding site (probably Kickstarter) in the middle of 2025. KEUMARS AFIFI-SABET

SENSEROBOT CHESS

PRICE US$999 (pre-order) ● AVAILABLE Due to ship September 2025

This AI-powered game-playing robot can help you master chess, with a 2-in-1 (chess and draughts) version also available. Its maker, SenseRobot (**senserobotchess.com**), is using **prelaunch.com** to raise funds to mass-produce its mobile game-playing robots for kids or even as a training partner for professionals. The chess robot's Apex Duel mode puts users up against an opponent with an Elo rating of up to 3,200, so higher than Magnus Carlsen (2,882) and Garry Kasparov (2,851) at their respective peaks. You can pre-order for US$999 now via **tinyurl.com/366chess**.

KEUMARS AFIFI-SABET

SWITCHBOT K20+ PRO

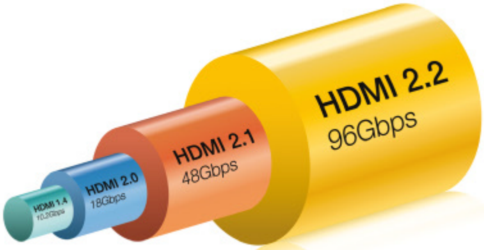
PRICE To be confirmed ● AVAILABLE Late 2025

At first glance you could be forgiven for thinking this is just another robot vacuum cleaner, but popping out from its centre are robot appendages that enable it to do so much more. The SwitchBot K20+ Pro can perform multiple tasks in the home thanks to its robotic arm and finger grips, from real-time monitoring to cleaning up rubbish and delivering meals to acting as a mobile humidifier. And it's customisable through modules you can design yourself. The strangest release of CES? It's up there.

KEUMARS AFIFI-SABET

BEST OF THE REST

There's never any shortage of weird and wonderful products on show at CES, with these simply the highlights from the deeper recesses of the event's many halls.



HDMI 2.2

PRICE Not applicable ● **AVAILABLE** Late 2025

The HDMI specification body used CES to announce HDMI 2.2, an upgrade on the current 2.1 version. As you would expect, it has lots of shiny new features – specifically around faster data rates and hence higher resolutions and frame rates.

You can share the 96Gbits/sec of data bandwidth between resolution and frame rate, so although HDMI 2.2 supports panels at 16K resolution, it can also do 4K at a 480Hz frame rate. There are new features in the specification for latency management, too, which will be handy.

All of which sounds great, but sales of 8K TVs are weak due to lack of content and high power consumption. It's hard to see a broader need for these new 2.2 capabilities, but doubtless vendors will try to sell them to us. And there will be a wait. The current version, HDMI 2.1, was announced back in 2017 but took years before it came to market in shipping TVs and gaming consoles. The same will happen with 2.2: initial product announcements later this year at the highest end of TV products, with more mainstream support coming in a few years' time. JON HONEYBALL

NVIDIA PROJECT DIGITS

PRICE & AVAILABILITY To be confirmed

Want a supercomputer on your desk for building AI engines? Nvidia has just the box: a small form factor unit with the GB10 Grace Blackwell Superchip inside. Along with 128GB of RAM, DIGITS can build and run models with 200 billion parameters. Once you've fine-tuned everything, the model can be deployed to the cloud or a data centre for operational use. At around £3K, this isn't a toy, but it is a computing monster designed for specific uses – and for those developers, the price will be immaterial. Availability is claimed for later this year and I'm sure the queue is already long. JON HONEYBALL

SWIPPITT

PRICE TBC ● **AVAILABLE** June

If your house is anything like mine, it will normally have a teenager dangling off the sofa, holding a phone lashed to the wall, because it ran out of charge for the third time today.

Swippitt promises to end the ceaseless charging nightmare with a toaster-like device that contains five batteries. Pop your phone – wrapped in a special Link case – into the toaster (they call it a Hub), and two seconds later it pops back up with a fully charged battery installed. The company will sell Links for iPhones, Samsung Galaxy and Google Pixels to start with. It's not cheap, but if it works as well as it did in the demo, it's brilliantly convenient. BARRY COLLINS

MOANA WAVE T5

PRICE ~$200 ● **AVAILABLE** From February

I hadn't heard of the brand Moana before stumbling across its stand in the Las Vegas Convention Center South Hall, but I'll definitely be watching out for new products from this audio specialist (in fact, we recorded the *APC* podcast from the show using one of its desktop mics). In particular, I've asked the company to send me the Wave T5 set when it becomes available, as it's a hugely convenient pair of wireless Lavalier microphones with a range of up to 100 feet. Connect the USB-C adapter to your phone, clip mics to your presenters' lapels, and it's ready to work. With five hours of charge, and up to 20 hours via the box, it's a bargain at an expected $200. TIM DANTON

KEYCHRON K2 HE KEYBOARD

PRICE From $249 ● **AVAILABLE** Now

The black version of the Keychron K2 HE has real Atari vibes: black plastic with a walnut veneer on the edges that gives it a retro charm.

The K2 HE uses the Gateron Double-Rail Magnetic Switch, which allows you to customise the actuation point and even assign multiple actions to a single key based on travel depth (in other words, tap lightly for one function, press harder for another).

I had only the briefest of hands-on plays on the Keychron stand, but it felt lovely under the fingers, and the keyboard has the reassuring heft that means even hammer-fisted typists won't shift it. BARRY COLLINS

EVEN REALITIES G1 AR GLASSES

PRICE From US$599 ● **AVAILABLE** Soon

Most smart glasses I tried at CES were dire. Even Realities shows promise, however, with a clever optical waveguide to bring the text panel into the centre of your field of view – much like the HUD in a car. It has a useful window size and crisp text. And best of all, it's shipping now. It tethers to an app on your phone, which provides direction information (not when driving), AI-based translation, quick notes, reminders and a teleprompter mode. Starting from just under US$600, this is not a cheap plaything, but you can order prescription lenses and varifocals. What I saw – mostly a text display projected into my line of sight – was head and shoulders above the competition, but it will live and die by the app. JON HONEYBALL

RAZER PROJECT ARIELLE

PRICE $2,000+ ● **AVAILABLE** Prototype only

Face facts, gamers: you can get awfully sweaty when trying to take down the teenagers in *Counter-Strike*. And we do mean awfully.

Razer's prototype chair is fitted with air conditioning to combat this, blowing cold air around the seat when you're

TCL NXTPAPER 11 PLUS

apc
BEST OF CES 2025

PRICE & AVAILABILITY To be confirmed

It's becoming increasingly difficult to tell Android tablets apart from each other, but buy the TCL Nxtpaper 11 Plus and you'll have no such problem. It uses TCL's new Nxtpaper 4.0 technology for rich colours when you want them, but press a button on the side and it transforms into an E Ink-like black and white. You can choose a focus mode, too, to hide attention-sucking apps and quieten notifications. But this 11.5in tablet isn't a one-trick pony, with AI tools to help you write, plus Google's Circle to Search – and the latter will work with your finger or the optional T-Pen. I only had a limited time with the tablet on the CES showfloor, but it's well made, sleek and extremely light. My only complaint is that TCL is keeping schtum on the specifications, price and release date, merely saying it will go on sale "this year". TIM DANTON

overheating or warm gusts if the home office is a little chilly on a February morning.

It's surprisingly effective, too. Razer's crowded CES suite was hotter than the sun, crammed with high-end gaming gear and staff who looked like they'd lost a few kilos demonstrating it. But when I was plonked in the chair with the cooling fans switched on, it was a glorious moment of respite… before they demonstrated the heaters and I wanted to run out of the room and dive into The Venetian's fake canals.

It's currently only a prototype, Razer insists, but it didn't half look like a finished product. Don't be surprised if it actually launches this year.
BARRY COLLINS

TARGET OMNI AUTO SCORING SYSTEM

PRICE TBC ● AVAILABLE Soon

If Luke Littler's heroics have you digging your dartboard out of the garage, here's an add-on to bring darts screaming into the 21st century.

The Omni Auto Scoring System is a plastic ring you mount around any dartboard. It contains LED lights and four HD cameras that can detect where each arrow has landed, even bounce-outs. That integrates with an Android/Apple app that allows you to keep score of local games, play against opponents online, and keep track of your stats. Note that the app costs extra after a three-month trial. BARRY COLLINS

TP-LINK DECO BE65-OUTDOOR

PRICE & AVAILABILITY To be confirmed

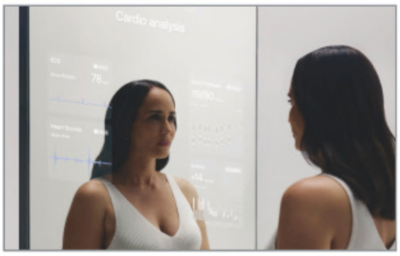
What the world has surely been waiting for: Wi-Fi 7 in your garden. Because this IP65-rated tri-band mesh node can be added to any TP-Link mesh Wi-Fi system to extend your network by 3,000 square feet. If your home is wired for Ethernet, you can power and add the Deco BE65-Outdoor to your network using a single cable. With a combined top speed of 11Gbits/sec, you can download or stream just about anything to any one of 200 connected devices. ANTHONY SPADAFORA

WITHINGS OMNIA

PRICE & AVAILABILITY To be confirmed

The Withings Omnia is an AI-powered mirror that gives you a full health assessment as well as showing your reflection. Along with data pulled in from other Withings gadgets, a base in the stand measures your weight, heart rate, blood pressure and metabolic health. Withings says it will also be able to run ECG scans and check for signs of atrial fibrillation.

You should be able to use the Omnia mirror to get feedback on the quality of your sleep, workout recovery and VO2 max monitoring. The mirror will display stats on screen, and give relevant feedback via an AI assistant. You might see a recommendation to book a check-up with the doctor, or to fit more active minutes into your day. In true AI chatbot fashion, you'll be able to ask questions about your health and get answers in return. For now, this is still in development, so there's no news on a price or a launch date.
DAVID NIELD



JON HONEYBALL'S HOT TAKE ON CES 2025

A visit to CES is always worth the time, effort and cost, because you'll see an entire planet's worth of IT thinking, dreaming and sheer desperation laid out in front of you.

This year, the world was clearly, if slowly, moving from the "AI with everything" we saw last year. Then, AI felt like a slap-on marketing tag, but many firms are making real progress in justifying the moniker.

The one big winner, of course, is Nvidia. A new range of graphics cards promises multiplier levels of speed increases. Although some accuse the company of "cheating" by using inferred frames to bump up the frame rate, it's hard to argue when you see the demos.

For me, though, Nvidia's Project DIGITS was the high point of CES 2025. Although it isn't yet a shipping item, it promises to bring true supercomputer levels of AI performance at a petaflop of speed to the desktop of any researcher or AI fiddler, for a cost close to a serious desktop PC. This will allow those who have the data sets and who want to build AI models, but don't want to splurge on paying cloud services, to build these models on local hardware. And then, owing to the strength of the Nvidia software and deployment platform, to roll these out at scale via cloud services if required. This is uncharted territory, but it will be fascinating to see how DIGITS is used. I predict a strong presence in healthcare diagnostics, as one example.

Wearable screens were another big topic, although most that I saw fell towards the "truly miserable" end of the scale. But a few were showing proper waveguide solutions that projected data into your line of vision, in a manner akin to a heads-up display in a car. Clearly there's a huge amount of work required to be done here to get a wearable AR product that is actually useful on a day-to-day basis, but many bright minds are working on it. By contrast, there were few demonstrations of solutions based on the Apple Vision Pro, but this wasn't surprising because of the per-user guest setup requirements. But quite a few companies had software to share via Apple's development platform code-sharing test environment, which I will follow up.

Healthcare, especially with lashings of AI overtones, was another big topic, although no-one has yet managed to create the Holy Grail of blood sugar monitoring done optically through the skin. Samsung boldly talked about whole-person health monitoring and AI-generated personal modelling, but this was really just arm waving around existing tech and the newly announced partnership with Continuous Glucose Monitoring (CGM) manufacturer Libre. And it was interesting to see vendors in the CGM space such as Dexcom announcing over-the-counter non-prescription CGM devices, to allow those who might be health-conscious or pre-diabetic to get a handle on their sugar processing.

Finally, I saw a big push towards making assistants look and feel like another human, both in the cloud and locally generated. I'm not sure this will be the right direction, and the "humanification" might be a dead end. Much is being done on seamless additional help that simply bolts on to your existing life – a tool that immediately and seamless converts between speech between two different languages doesn't need a talking head to make it work well. But this requires a bolder and more interesting approach, and it will be interesting to see who wins and loses when we return in a year's time for CES 2026. ■

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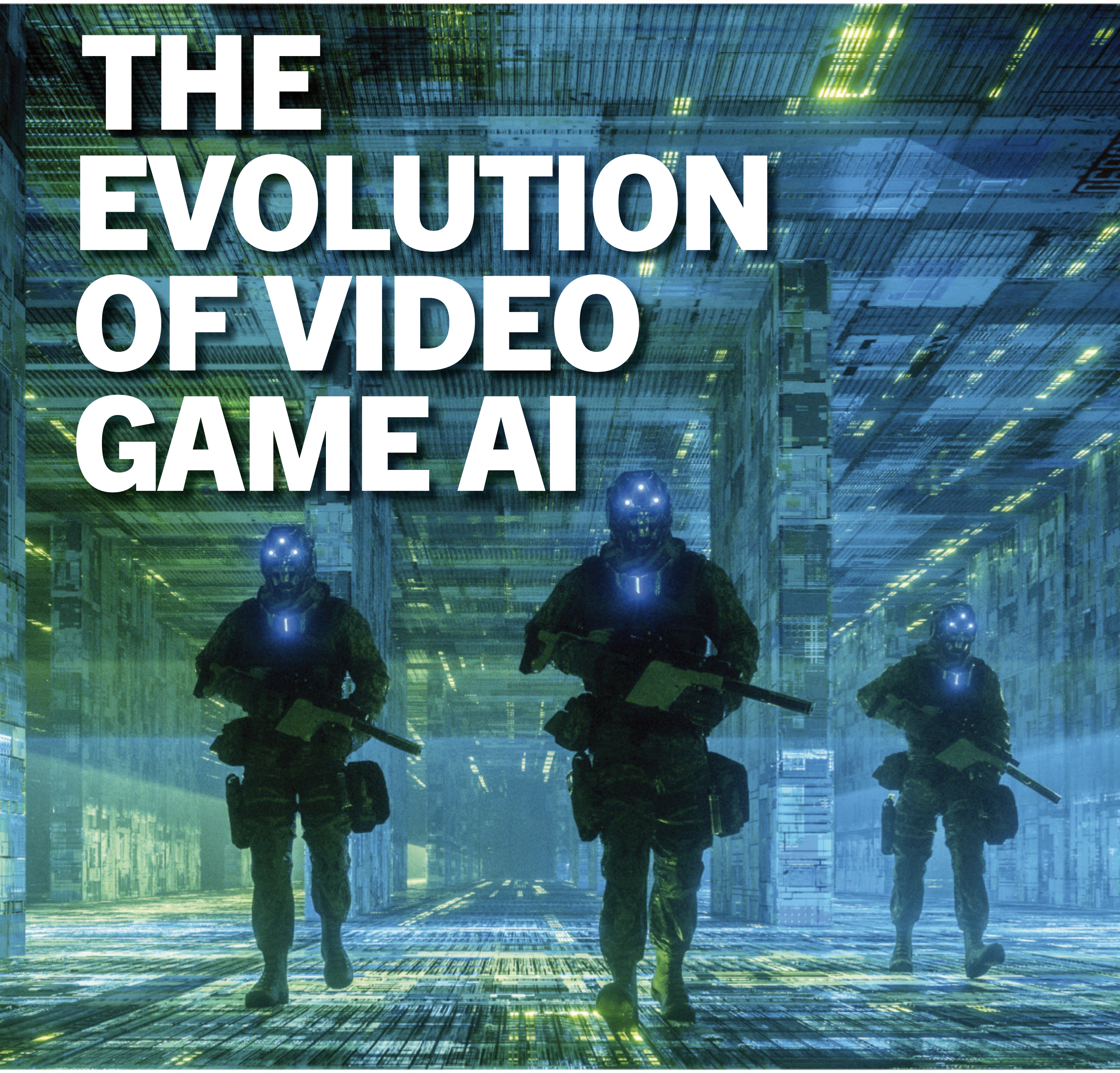
THE EVOLUTION OF VIDEO GAME AI



Over time, game AI has become more refined.

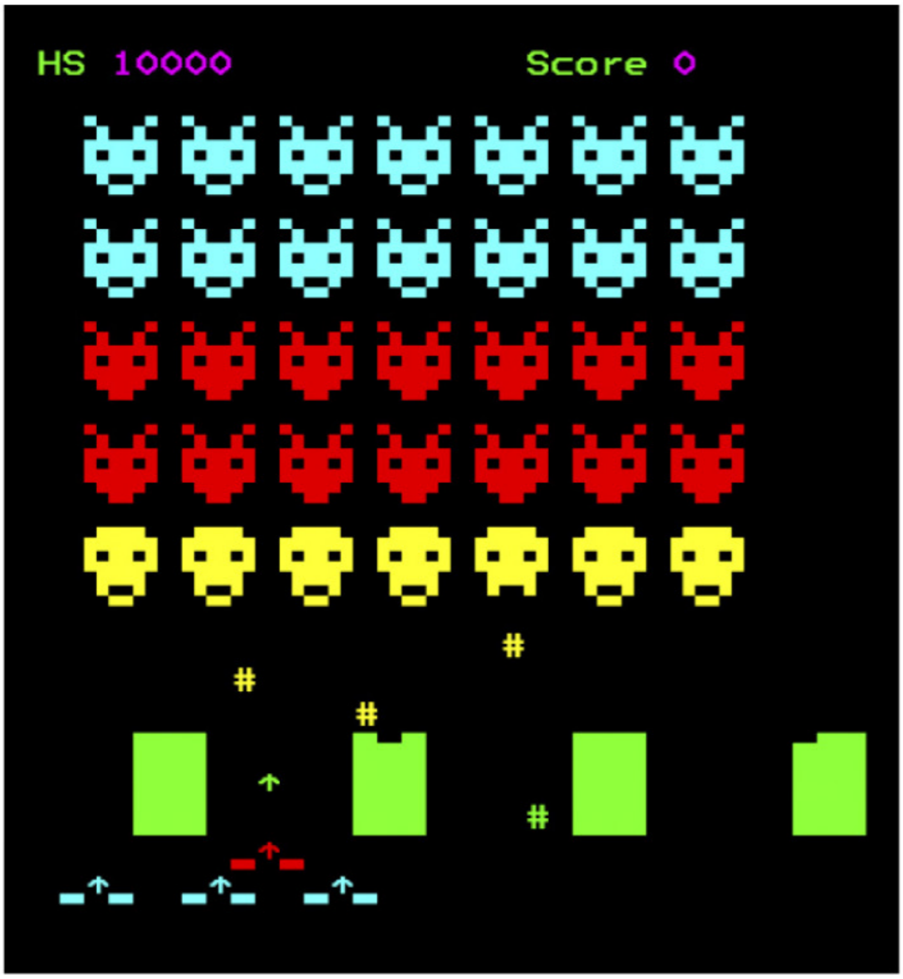
Anyone's who ever played *Space Invaders* or one of its many clones remembers how the aliens relentlessly bear down on the player until they're either destroyed or collide with your ship. This is one of the earliest examples of game AI (Artificial Intelligence), where developers made clever use of scripted responses to enemy NPCs capable of challenging players.

These days, AI can be used to do much more than have the *Pac-Man* ghosts run around a maze. Innovations like procedural content generation can spontaneously generate in-game items and even entire worlds. LLMs can even be used to inform enemy and other NPC behaviors, creating more realistic and convincing interactions.

Still, the course of in-game AI hasn't always run smoothly. Here, we'll chart its progress, from chess programs that were laughably easy to defeat, to how bleeding edge AI is used in modern games to enhance play and graphics.

Nate Drake

From lead to gold



Enemy AI in *Space Invaders* is limited, as the aliens don't respond to player actions.

In October 1960, philosophy professor Hubert Dreyfus published a RAND Corporation memo entitled 'Alchemy and Artificial Intelligence'.

In the paper, which formed the basis of his later book, *What Computers Can't Do*, Dreyfus launched a scathing attack on over-optimistic predictions about the field of AI, comparing it to the mythical process of alchemy.

He took particular issue with the claim by AI pioneer Herbert A Simon in 1957 that in ten years' time, a digital computer would be the world's chess champion. Dreyfus recognised the ability of Simon's GPS (General Problem Solver) programs to solve relatively simple tasks like the 'Cannibals and Missionaries' logic problem. However, he pointed out that the NSS chess program, which Simon had co-created in the late 1950s, had been beaten by a ten-year-old novice.

Drefyfus did go on to acknowledge gains in the field of AI. Still, his philosophical stance was that machines can't be intelligent in the same way as a human. In essence, he argued about the distinction between "knowing that" and "knowing how". Computers did and do excel at "knowing that" complex problems can often be solved by methodically trying every solution until finding one that works. The "knowing how" is a more human way of reasoning in context, such as standing on the strongest branch when climbing a tree. This reflects people's ability to intuit the best course of action without considering every alternative.

When it came to chess, this gave man an edge over machines, given that there are up to 10^123 legal and illegal moves. As early computers could only evaluate a few thousands moves per second, this meant that a computer opponent could take up to eight minutes to respond.

This wasn't lost on MIT undergraduate Richard Greenblatt, who had read a similar paper to Dreyfus's outlining the shortcomings of AI. Despite the misgivings of his thesis adviser, Greenblatt resolved to develop a program capable of playing tournament-level chess.

The program, later dubbed 'MacHack' was developed in stages on a PDP-6. Realising the enormous number of potential moves, Greenblatt applied 50 heuristic rules. These built on his own knowledge of chess, and the fact that 25% percent of all move sequences transpose to the same end position.

In 1967, a team of MIT researchers and students challenged Dreyfus to play a game against Mac Hack. After a long game, the computer ultimately checkmated the professor in the middle of the board.

By the time the program was published officially in 1969, it had already competed in 18 tournaments. The PDP-6 on which it was compiled was even made an honorary member of the Massachusetts State Chess Association and the United States Chess Federation.

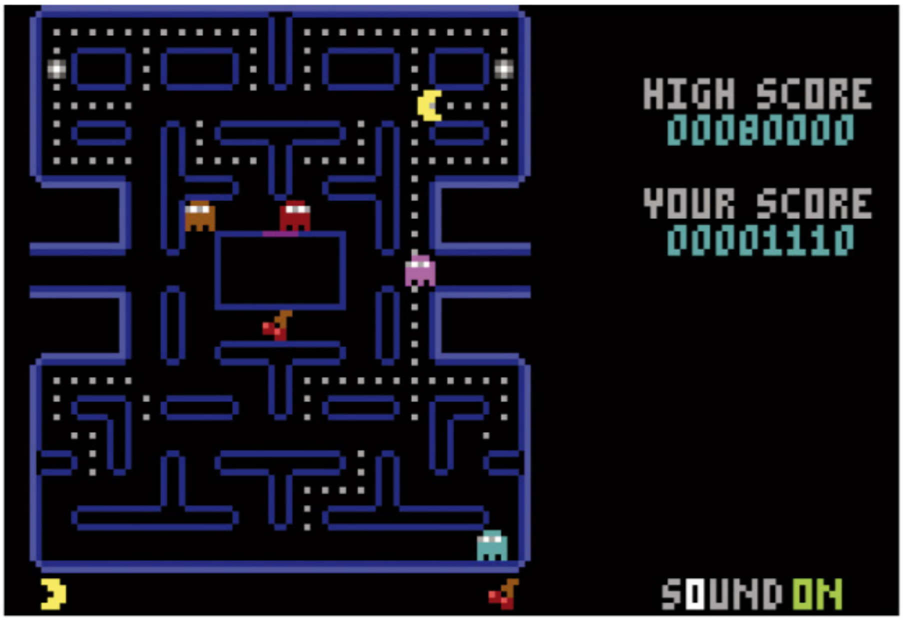
While the AI community may have felt vindicated, these types of programs were costly to develop, and could only run on extremely expensive hardware. This meant that some of the earliest video games released outside academia, like *Tennis for Two* and *Spacewar!*, were designed for two players, freeing up game resources to focus on graphics. This trend continued into the first arcade games released in the early '70s, as *Pong* and *Computer Space* were based on the aforementioned early videogames and relied on two human players.

Admittedly, the ball in *Pong* was programmed to move in response to how players moved virtual paddles. This rudimentary form of AI was also found in Taito's *Space Invaders* in 1978.

The aliens initially appear in rows at the top of the screen. They are deterministic in that they move from side to side and inexorably downward towards the player. While the game was one of the first arcade titles to introduce enemy NPCs, they cannot be described as intelligent. Even the UFO that moves across the screen is determined by calculating a random value, regardless of the player's actions.

The popularity of *Space Invaders* can be explained by other aspects of play, such as 'endless' play, in that the levels restart indefinitely. The original game control board also was able to render fewer aliens more quickly, resulting in faster movement the more aliens are killed. Developer Tomohiro Nishikado decided not to leave this bug in, as it made for more exciting play.

Strategies and states



Pac-Man's enemy ghosts each have a distinctive AI 'personality' determining their behaviour.

4
65%
01
AMMO
HEALTH
ARMS
ARMOR

Enemies in *Doom*-based titles won't attack until they see or hear the player.

The predictable patterns used by the alien NPCs in *Space Invaders* established a precedent that has since been held in videogames: it truly doesn't matter how objectively clever a game's AI is, provided the player perceives it that way.

In the '70s and '80s, when hardware processing power was relatively limited, programmers often struggled to create convincing AI for players. Still, Namco's *Pac-Man* (1980) was a quantum leap for both enjoyable gameplay and sophisticated enemy AI.

As *APC* readers know, creator Toru Iwatani programmed the game so that the eponymous hero moves around an enclosed maze, trying to gobble up coloured dots. Pac-Man is hindered in this by four ghosts, who will chase him down. If Pac-Man comes into contact with a ghost, he loses a life, and the level restarts.

Even in the early Eighties, programming a 'maze chase' game wasn't too difficult. Iwatani could easily have just had the ghosts move around randomly, colliding off walls or even program them all to converge on the player. However, part of *Pac-Man*'s charm is that each of the ghosts are individually programmed with their own 'personality'.

For example, Blinky's (red) personality is described as 'shadow' in the game documentation. True to form, he will give direct chase to Pac-Man by being programmed to head to whatever game 'tile' the hero currently occupies by the shortest route possible.

The pink ghost (imaginatively named 'Pinky') has a 'speedy' personality. She operates by examining the game grid and calculating a position four tiles ahead of Pac-Man, which then becomes her 'target tile'. This doesn't necessarily have to be somewhere the ghost can actually reach; it just informs Pinky's movement, often resulting in her cutting off unwary players. Of course, in a situation where Pac-Man is being pursued by Pinky, the player can always briefly reverse direction to change the ghost's target tile.

The cyan ghost Inky is configured with a 'bashful' personality. The ghost waits to pursue Pac-Man until the player has consumed at least 30 dots. It then calculates its target tile as a vector based on both Pac-Man and Blinky's position. If the player isn't near Blinky, this can result in highly unusual movement patterns.

The orange ghost, Clyde, is described as 'pokey', given that he appears to be unconcerned with Pac-Man's movements. However, this is a feint. In fact, Clyde switches between two states. If the ghost is within eight tiles of Pac-Man, it will chase him in the same way as Blinky. If not, Clyde will move to his 'scatter' tile at the bottom-left corner of the maze.

As any *Pac-Man* player knows, the overall effect of these simple AI rules requires constantly adapting to the movements of all four ghosts, resulting in a highly challenging and interesting game.

Given that this isn't a treatise on *Pac-Man* alone, we haven't touched on the different 'modes' ghosts can enter, such as 'scatter', when they move to a predetermined position on the screen, or 'frightened', when Pac-Man is chasing them after eating a power-up pill.

Still, even the AI for simple games needs to record the state of the player, enemies, and objects. In *Pac-Man*, this can be done through simple algorithms – the ghosts are either in 'chase', 'scatter', 'frightened', or 'dead' mode.

However, this is difficult to scale for more complex titles. This is where FSMs (Finite State Machines) are useful. These are a good way to categorise behavior of game elements like enemy NPCs, as well as the conditions by which you can change from one to another.

One of the best examples of FSMs being applied to games is the *Doom* (1993) engine. All state definitions in the game are stored as a global array. This defines information like which sprites to play for the 'actor' in question, its dimensions, health, and so on. For instance, in *Doom*, each time you start a level, enemies are typically placed at certain locations in the 'spawn' state. This means they are fixed to a particular tile, though typically two sprites are defined to make the enemy look like they're walking in place.

If the player makes a sound by firing a weapon or moves in the enemy's line of sight, they will enter the 'see' state and begin hunting the player by moving toward them by the shortest path. If the enemy gets close enough, it can enter a 'melee' state to physically attack them. Enemy NPCs with ranged weapons can also enter a 'missile' state to open fire on them.

If the player fights back, this triggers the P_DamageMobj function, which determines the enemy's state. For example, if the player fires back and injures the enemy, the *Doom* engine calculates a random value based on the enemy's predetermined 'pain chance' to determine if the 'pain state' is activated, so it reacts to being injured.

Attacking an enemy also means that its current target is set to the player, so if it wasn't doing so before, it will use its specific attacks against them.

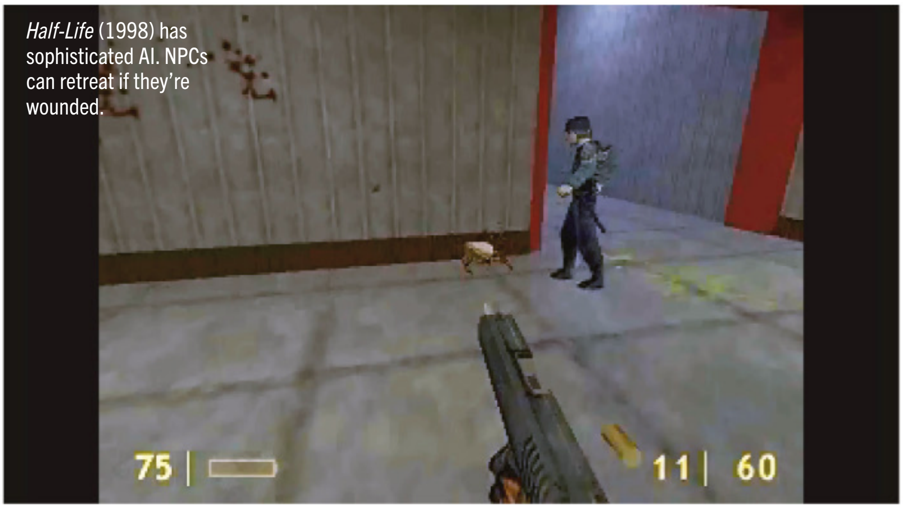
Branching out

While procedural generation and language models were years away, the ’90s did see some improvements in classical game AI. Valve’s *Half-Life*, for instance, used a more sophisticated FSM than earlier titles. As with *Doom*, enemies still patrolled sectors of the map and attacked if they detected the player. However, they could also retreat if the player approached too close or they were taking too much damage.

This was one of the first instances of ‘hierarchical’ finite state machines. This essentially allowed for multiple FSMs within FSMs. For example, you could have one state machine managing an enemy’s behaviour at rest, such as patrolling an area. If the enemy detects the player, it can move to another FSM that manages attacking behaviours. Should it get too damaged, an FSM can be enabled to manage its actions when retreating. This approach is still used in games, including the 2016 remake of *Doom*.

Half-Life also pioneered ‘goals’. These are overriding AI directives that NPCs will try to accomplish unless programmed otherwise. The game has five, such as GOAL_ATTACK_ENEMY, which causes an enemy to fight the player unless a state is triggered, causing it to retreat or die.

The concept of an NPC that follows instructions according to a game’s internal logic was developed further with ‘behaviour trees’. One of the earliest examples was coded into *Halo 2* (2004).


Half-Life (1998) has sophisticated AI. NPCs can retreat if they’re wounded.

Behaviour trees are made up of ‘nodes’ and ‘branches’. Nodes have elements of game logic, and branches define what nodes to examine. Sequence nodes determine the order in which child nodes are executed. Conditional nodes execute sub-trees under in-game conditions. Behaviour trees also have ‘leaves’ with no child nodes. Behaviours are defined here.

In *Halo 2*, the ‘Brute’ enemy will usually attack the player under all circumstances. However, the ‘Grunt’ enemy tends to run away from battle if its leader is killed. Behaviour trees make it simpler to code AI behavior, as parent nodes can determine generalised behavior, while child nodes can be specific to each type of NPC.

However, there are times when enemy actions as determined by the game’s built-in ‘priority’ list aren’t appropriate. This is where the AI can activate an ‘impulse trigger’ to prompt the enemy down a different branch of its behaviour tree. For instance, if the player takes cover inside a vehicle, the enemy will also try to enter.

Gaming the AI

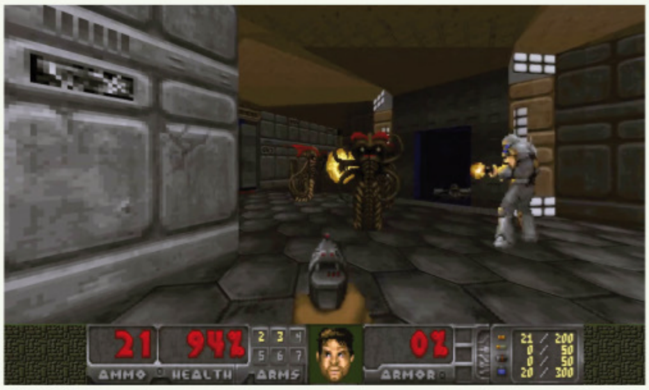
While *Doom*’s FSM resulted in the appearance of a sophisticated enemy AI, anyone who has played the game at lengths knows it has its limits. For instance, sounds from weapons can spread across sections, waking enemies up from the ‘spawn’ state and causing them to rush the player. For this reason, most level editors support a ‘Deaf’ flag to prevent enemies in different sections from activating before a player is ready.

There’s also no hard-coded limit on most enemies’ line of sight, meaning flying enemies like the Cacodemon can detect and approach long before they’re visible to players.

Typically, enemies react to being attacked by setting whatever injures them as the current target. Skilled players can use this to game the enemy AI and trigger ‘Monster infighting’.

In essence, this involves tricking one enemy to attack another through unintentional friendly fire. If one monster blocks another’s line of sight, the AI requires enemies to keep attacking. The monster may shift their target from the player to the other enemy that injured it, then attack them. Triggering monster infighting is easiest with enemies who perform missile attacks.

One classic example is *Doom II*’s MAP20: Gotcha level, which contains two of the most powerful enemies in the game: a Spider Demon and a Cyberdemon. It’s easy to get one hit to accidentally hit the other, triggering a bloody battle between the two.


The AI in *Doom* can by tricked to make enemies attack each other.

All titles that use the *Doom* engine, like *Hexen*, can be gamed like this. However, when id released *Quake* (1996), the AI was updated so enemies of the same kind won’t fight each other.

Players have continued to exploit infighting in other titles. For example, many of the hostile AI ‘mobs’ in *Minecraft* can be tricked into fighting if the player can get one to damage the other.

Driving directions

While hierarchical FSMs and behavior trees generate more realistic behavior from NPCs like enemies, it doesn't necessarily make for better gameplay or good replay value.

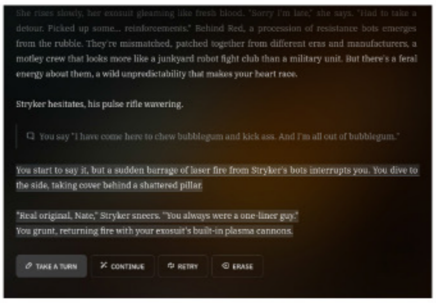
Valve's *Left 4 Dead* (2008) addresses this by introducing 'Director-based AI'. In the game, the AID (AI Director) eschews traditional spawn points for enemies. Instead, it determines the location and numbers of 'the Infected' based on a number of factors, like the current player's skill level.

When a map loads, the AID can also place certain items at predetermined spawn points. These vary depending on the player team's performance. For instance, if team members are injured, the Director can place health kits.

The game's 2009 sequel gave the AID much greater powers through dynamic map design, again based on team performance. One example is found in the 'Cemetery' stage of the final 'Parish' campaign. If a player's team is doing too well, they will find more gravestones blocking their route.

The *Forza* racing game franchise also represented a great leap forward for in-game AI. When *Forza Motorsport* first hit the shelves in 2005, few players knew that the 'drivatar' AI for other in-game cars was built on studies by Microsoft's Research Lab in Cambridge, UK.

Left 4 Dead's AI director changed game conditions depending on team performance.



She rises slowly, her exosuit gleaming like fresh blood. "Sorry I'm late," she says. "Had to take a detour. Picked up some... reinforcements." Behind Red, a procession of resistance bots emerges from the rubble. They're mismatched, patched together from different eras and manufacturers, a motley crew that looks more like a junkyard robot fight club than a military unit. But there's a feral energy about them, a wild unpredictability that makes your heart race.

Stryker hesitates, his pulse rifle wavering.

You say "I have come here to chew bubblegum and kick ass. And I'm all out of bubblegum."

You start to say it, but a sudden barrage of laser fire from Stryker's bots interrupts you. You dive to the side, taking cover behind a shattered pillar.

"Real original, Nate," Stryker sneers. "You always were a one-liner guy."
You grunt, returning fire with your exosuit's built-in plasma cannons.

Text-based AI games can create new content, as determined by the player's actions.

The first *Forza Motorsport* used a Bayesian Neural Network to record racing lines and characteristics of how the player drove their car. It would then use this data from previous races to calculate the feasibility of solutions to problems. For instance, if a 'drivatar' car is approaching a corner, said data can be used to determine the optimal angle and acceleration to turn successfully.

Initially, this data was saved to the Xbox's internal 8GB Memory Unit. The saved data was then used to train the drivatar AI each time the player raced. However, as of *Forza Motorsport 5* (2013), the series makes use of the Xbox One cloud and a reinforcement learning (RL) paradigm to record data for all players connected to the cloud. This allows new behaviour models to be calculated for Drivatar behaviour. Players can even download new AI cars with updated behaviour. All player driving data is recorded and timestamped. The drivatar AI favours newer data for training, on the basis that player performance on tracks will improve over time.

Procedural Content Generation

The *Forza* franchise is an excellent example of how deep learning using ANNs (Artificial Neural Networks) can be used to adapt to player behavior, providing better replay value and a more enjoyable gameplay experience.

In the case of the AI racing cars in *Forza Motorsport*, the process used is a form of 'reinforcement' learning by analysing past player driving performance and trying out strategies to navigate obstacles like corners to find an optimal approach.

Another exciting aspect of machine learning in videogames relies on using PCG (procedural content generation). One of the earliest examples of this was *Rogue* (1980). The game's algorithm worked by generating a dungeon room into which the player would spawn. It would iterate at random through more rooms, determining if each was accessible by its neighbor, then placing stairs in the last room, so players could proceed to the next level.

Although the scope and type of generated content are greater, *Minecraft*'s world generation operates in a similar way. The game AI begins with a 'noise map' generated using random numbers from a quadratic congruential generator. This represents basic land to ocean at a ratio of 1:10.

The 'biome' map, such as deserts or mountains, is selected. A basic outline for the map determines the height for each region with surface stone blocks. Surface stone blocks are placed on these, appropriate to the biome. Finally, elements like ravines, trees, and villages are added.

The PCG in both *Rogue* and *Minecraft* are excellent examples of 'random assembly', in that manually created elements, such as dungeon rooms or grass blocks, are assembled together via an algorithm.

No Man's Sky (2013) expanded this concept further by generating entire universes via machine learning. Almost all planets, creatures, ships, multi-tools, and other items are created via procedural content generation.

While developer Hello Games hasn't detailed how this works, founder Sean Murray has said that the player's position is used to inform the LSS (Local System

Robo moderators and upscaling

According to a recent report from Unity, toxic behaviour in gaming increased from 68 percent in 2021 to 74 percent in 2023. Around one third of this is accounted for by cheating. Kernel-level anti-cheat systems like Vanguard protect titles developed by Riot Games, like Valorant (2020). This is problematic, as it requires high-level access to players' systems, sometimes when the game isn't running.

Cheaters are also becoming more innovative at bypassing kernel-level cheats, such as by using custom hardware. This is why anti-cheat systems combine kernel-level software with server-side monitoring and machine learning.

For instance, *Fortnite* cheaters often install unauthorised 'aimbot' software to calculate the trajectory of a player's shots, then aim their gun at a target. Epic Games' EAC (Easy Anti-Cheat) deploys AI to examine player behavior. This data can be gathered against statistics gleaned from other players to determine average statistics for aim time and precise shots.

Naturally, AI is also used to combat other forms of bad behavior, like harassment. This hasn't always been received well. For instance, the AI moderation tools in *Elder Scrolls Online* reportedly monitor all in-game conversations, so players could get banned for private conversations or light-hearted taunting between friends if certain keywords are detected.

The use of artificial intelligence to improve videogame graphics has been much better received. One of the most significant advances in this field is Nvidia's Deep Learning Super Sampling (DLSS) technology. It uses AI to enhance game assets like textures, shadows, and environmental details in real-time.

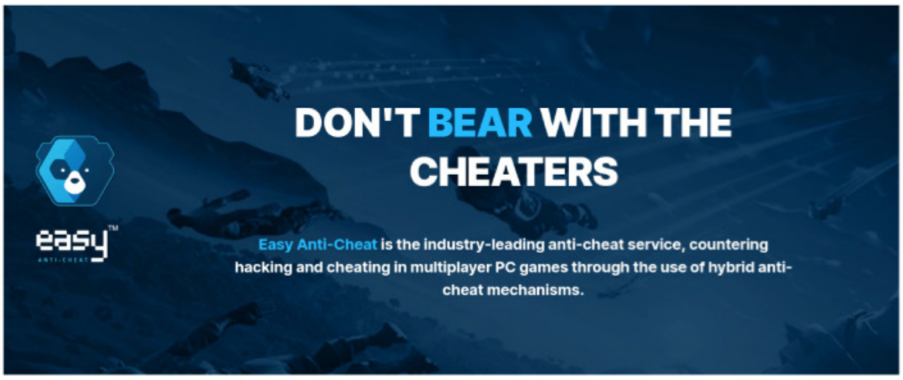
This is achieved through multiple techniques. For instance, GeForce RTX GPUs can use AI to ouput higher-resolution frames from a lower-resolution input. DLSS achieves this by sampling multiple low-res images, then uses motion data and feedback from previous frames to reconstruct high-quality images.

For instance, the latest version of *Cyberpunk 2077* supports DLSS 3.5, which includes 'ray reconstruction'. This uses AI to generate additional pixels for intensive ray-traced scenes, which is more efficient than hand-tuned denoisers.

AMD also plans to deploy version 4 of its FidelityFX Super Resolution (FSR) technology in titles like *Call of Duty: Black Ops 6*. Like DLSS, FSR 4 will use AI-based techniques for upscaling graphics. The company also plans to use frame generation and interpolation to improve game battery life on handheld devices.

Moderation and anti-cheat systems sometimes raise false positives. Titles that use procedurally generated content to create worlds can look uninspiring compared to manually designed in-game assets. Relying on AI to generate graphics and dialogues for NPCs can be problematic if they reinforce harmful stereotypes or don't move the game forward. Still, there's no denying that players can become frustrated with NPCs' repetitive actions and speech.

A recent report into the future of NPCs found that 99 percent of gamers feel that AI will enhance gameplay. As the technology is further integrated into popular titles, time will tell. ■



Easy Anti-Cheat is the industry-leading anti-cheat service, countering hacking and cheating in multiplayer PC games through the use of hybrid anti-cheat mechanisms.

Anti-cheat systems can detect anomalous behaviour like extremely high firing accuracy.

Seed) used to calculate content like planets and terrain.

However, PCG has limits when it comes to world building. When *Cyberpunk 2077* was released in 2020, CD Projekt Red's lead cinematic animator, Maciej Pietras, emphasised that the game's 'Night City' would be an open world, but created manually. He said that this was due to the difficulty of procedurally generating realistic virtual content like tall buildings, as compared to open terrains like those used in *The Witcher 3*.

In the same year, Nick Walton of Brigham Young University's deep learning lab released *AI Dungeon*. The initial release used an early version of the GPT-2 natural-language-generating neural network created by OpenAI.

It was inspired by tabletop games like *Dungeons & Dragons*, where players can take actions within parameters defined by a dungeon master. The AI generated a finite list of functions. However, later versions of *AI Dungeon* were built on full GPT models, trained on content from sites focused on interactive gamebooks. This leverages machine learning to offer near complete control of the story.

The game prompts players to choose a genre, such as fantasy or cyberpunk. After the adventure begins, the game will respond to any action or speech the player enters. It also supports a 'story' mode, where players can have the game remember key plot details, such as that a particular door is unlocked.

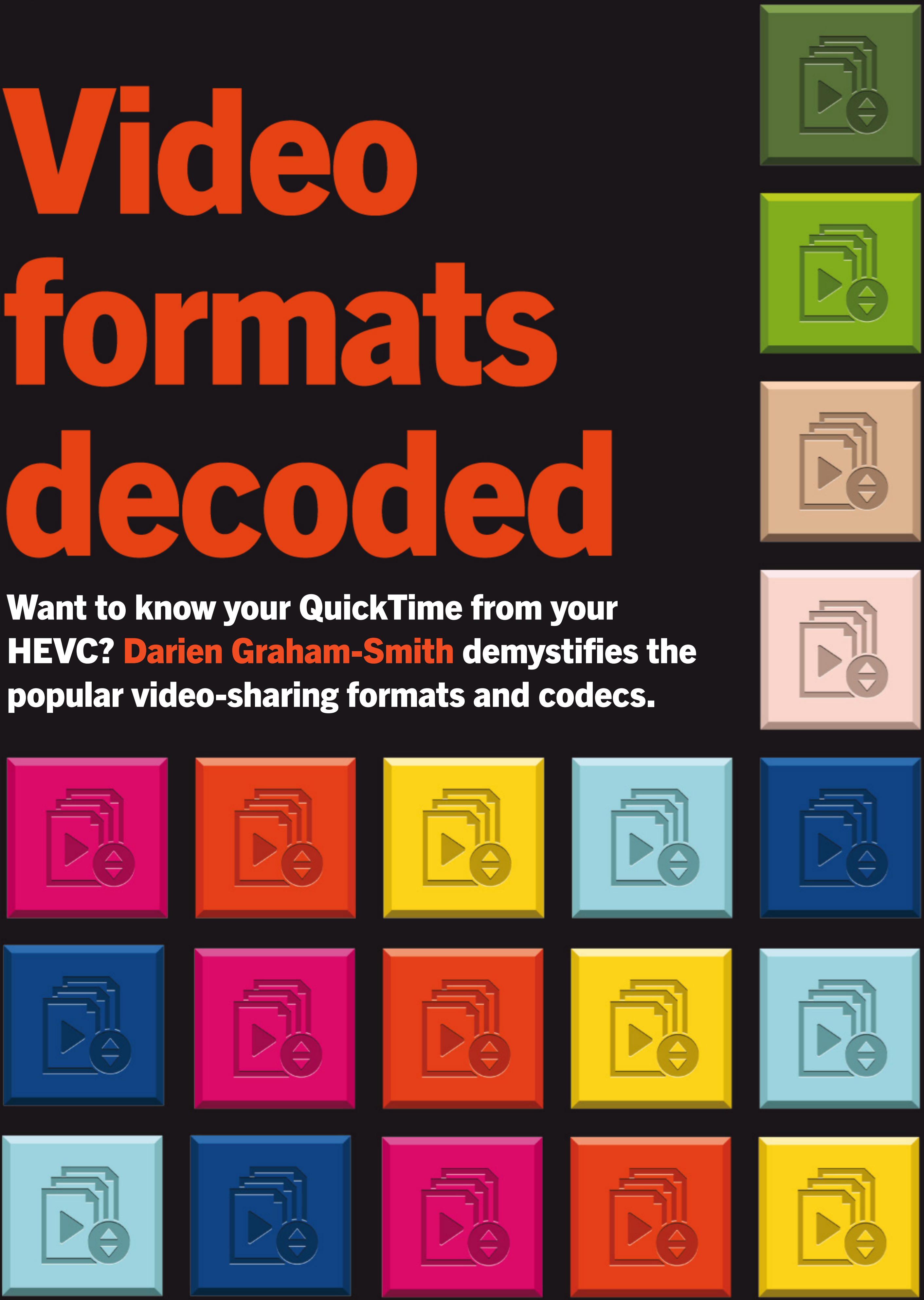
This is easy to achieve, as *AI Dungeon* is text-based. Currently, there are no commercial graphical titles using machine learning to dynamically craft NPC responses and missions in response to user input.

In 2023, Replica Studios gave gamers a taste of things to come with a demo of its 'Smart' NPC plugin for Unreal Engine 5. In theory, this can be powered by OpenAI or a developer's own language model to make NPCs react in a more realistic way, creating more immersive stories.

Shortly after its release, videogame enthusiast Trevor Martin put the plugin to the test in a vast simulated city by approaching Smart NPCs and trying to convince them that they were living in a simulation. Though we wouldn't encourage readers to try this in real life, the NPC responses were quite plausible. In most cases Martin wasn't believed. Other NPCs resolved to continue living their 'best life', despite knowing they weren't real.

Video formats decoded

Want to know your QuickTime from your HEVC? Darien Graham-Smith demystifies the popular video-sharing formats and codecs.



While capturing and editing video is easier than ever, the fighting file formats are a pit of complexity. We're asked to choose between AVI, MP4, H.264 and so forth, but what's the difference between them?

Here's everything you need to know to produce the best videos for your needs, whether you're looking for smaller files, fast transcodes or the best possible quality.

The big picture

The fundamental reason why all these different formats exist is that each frame of video – in the form that we see on our screens – is huge. A single frame of Full HD video consists of 1,920 x 1,080 pixels, which is to say just over two megapixels. If each pixel were represented by a single bit, the full frame would represent over two megabits (that is, 250 kilobytes) of raw data.

And of course we don't use one-bit video, as that would mean each pixel would only be either black or white. Most mainstream media uses a 24-bit colour palette, with eight bits representing each of the red, green and blue components for a palette of 16,777,216 colour tones. This allows for subtle colour gradients and shades that look (to the human eye) perfectly smooth, with no blocky aliasing. It also pushes up the raw size of the frame to 1,920 × 1,080 × 24 for a total of 49,766,400 bits. In other words, just under 50 megabits, or around 6.2 megabytes.

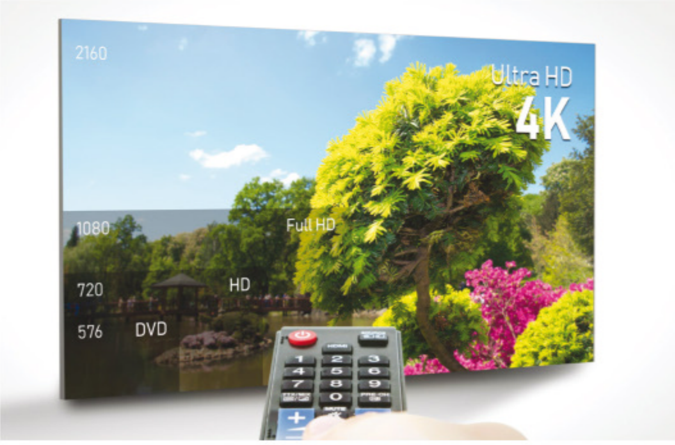
Then of course we need to think of the time domain. A typical Hollywood film will be shot at 24 frames per second, so one second of footage represents 49,766,400 × 24 bits for a total of 1,194,393,600 bits. That's equivalent to around 150 megabytes per second, so a two-hour film equates to more than a terabyte of data. This is an inconveniently large amount of information to be working with. And that's before we consider HDR media, which typically uses ten bits of colour data per pixel, or higher frame-rate media, shot at 30fps or even 60fps. 4K media is four times the pixels – and hey, you might like to include some sound with that video, too?

It's clear that, for us to be able to edit, share and store video data on our personal devices, it needs to be compressed down to a manageable size – and this is where all the different file formats come in.

Containers and codecs

Let's start by clearing up a common point of confusion. The file formats we commonly refer to as "video files" actually carry two types of information: the video itself and the accompanying audio content. Aside from the fact that these elements are intended to be played simultaneously, they're quite independent of each other, and are encoded and stored separately inside what's called a container file.

In fact, container files often contain more than two data streams. For example, there might be multiple selectable audio streams for 5.1 or DTS playback, or even a separate stream for embedded commentary. Metadata such as subtitles and chapter divisions can be stored in the container file, too.



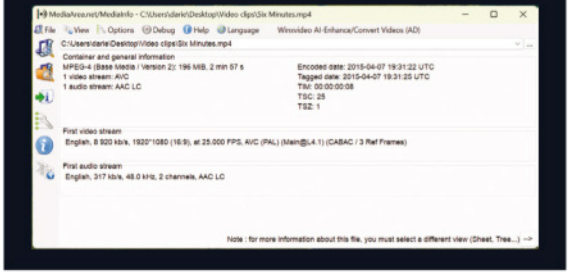
ABOVE As detail increases, the size of the raw video data becomes huge.

What's in the container?

If you're curious about the make-up of a particular video file, there are plenty of tools you can use to look inside its container. One free, open-source choice is called MediaInfo (**https://mediaarea.net/en/MediaInfo**).

You can use MediaInfo by dragging any video file into the application window, or right-clicking on a video file in Windows File Explorer and selecting "MediaInfo" from the contextual menu.

You'll now see a "Basic" view, showing a breakdown of all the data items contained in the file. Under "First video stream" you'll see the specified language of the primary video file, along with its bit rate, resolution, frame rate and compression format; below, similar information is shown for the first audio stream. For more details, open the "View" menu and select "Sheet" or "Tree" to browse embedded metadata and other details of the file.


MediaArea.net/MediaInfo - C:\Users\darle\Desktop\Video clips\Six Minutes.mp4
File
View
Options
Debug
Help
Language
Winxvideo AI-Enhance/Convert Videos (AD)

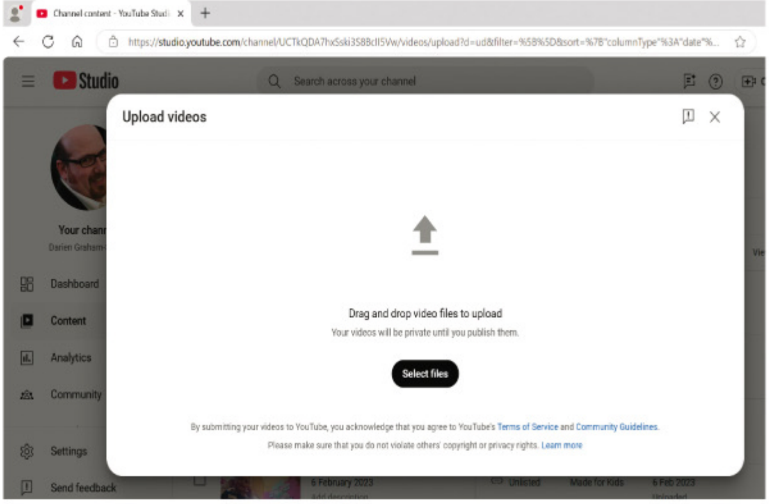
```
C:\Users\darle\Desktop\Video clips\Six Minutes.mp4
Container and general information
MPEG-4 (Base Media / Version 2): 196 MiB, 2 min 57 s          Encoded date: 2015-04-07 19:31:22 UTC
1 video stream: AVC                                           Tagged date: 2015-04-07 19:31:25 UTC
1 audio stream: AAC LC                                        TIM: 00:00:00:08
                                                              TSC: 25
                                                              TSZ: 1

First video stream
 English, 8 920 kb/s, 1920*1080 (16:9), at 25.000 FPS, AVC (PAL) (Main@L4.1) (CABAC / 3 Ref Frames)

First audio stream
 English, 317 kb/s, 48.0 kHz, 2 channels, AAC LC

Note : for more information about this file, you must select a different view (Sheet, Tree...) -->
```

Many different container formats have been developed over the years. Older ones include Audio Video Interleave (AVI), Matroska video (MKV), WebM (WEBM), Microsoft's Windows Media Video format (WMV) and the Third-Generation Partnership Project (3GP) format, designed for sharing videos over 3G mobile networks. Now, though, the industry has settled on two standard container formats: MPEG-4 (M4V or MP4) and QuickTime File Format (MOV). All current video-encoding and playback applications will support at least one of these formats, so unless you're working with archive footage you can forget about the rest.

The container format is only half of the equation, however. The other question is what compression system has been used for the data streams inside. Audio content almost invariably uses Advanced Audio Coding (AAC) compression, but there have been dozens of different systems developed over the years for encoding and decoding video data ("codecs", for short), MP3 being the most famous. Thankfully, again, only a few of them are in widespread use today.

All the mainstream video codecs are "lossy", meaning they trade off file size for fidelity, but they're also all fully configurable, so the person exporting the video file can decide whether to create a large file with very high-quality content or trade off fidelity for a smaller file size. At the point of encoding they can also scale the original video data to their desired resolution, and choose how many bits to use for colour data.

These numerous decisions determine the eventual bit rate of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https://studio.youtube.com/channel/UCTkQDA7hxSski358BclI5Vw/videos/upload?d=ud&filter=%5B%5D&sort=%7B"columnType"%3A"date"%...
Studio
Search across your channel
Your chann
Darien Graham-
Dashboard
Content
Analytics
Community
Settings
Send feedback
Upload videos
Select files
6 February 2023
Add description
Unlisted
Made for Kids
6 Feb 2023
Uploaded

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Your videos will be private until you publish them.

By submitting your videos to YouTube, you acknowledge that you agree to YouTube's Terms of Service and Community Guidelines.

Please make sure that you do not violate others' copyright or privacy rights. Learn more

LEFT All major video-sharing services will accept MOV and MP4 files.

the file – that is, how many bits of data are stored for each second of video. Although a low bit rate generally corresponds to low overall quality, different codecs can produce differing results, and it's also possible to use slower, more computationally expensive encoding methods to pack more detail into a given number of bits. The upshot is that the use of a particular container format, and even a particular codec, doesn't necessarily tell you much about the quality or resolution of a video file.

Which video format should I use?

If you've ever shot your own videos, edited existing footage or re-encoded old files to save space, you may have wondered which file format is best for your output. As we've seen, it doesn't matter which container format you use, as long as you choose one that's supported by your target platform or application. In fact, beginner-friendly video apps such as Microsoft Clipchamp may only support a single output format – typically either MOV or MP4, since these are by far the most widely used file types. You won't go wrong if you stick to one of these industry-standard formats, as all the major sharing platforms will accept them, including Facebook, Instagram, TikTok, Vimeo and YouTube.

Depending on the software you're using, you may also be able to choose between codecs, the most common being H.264, H.265 (also known as HEVC) and Apple's high-quality ProRes encoder, which comes under its QuickTime branding. These codecs each have their own strengths and parameters, as we'll discuss below.

If you have the option to choose a frame rate, it normally makes sense to match the frame rate of your source footage, as converting it will slow down the export process and could make the video look jerky. Clipchamp and Apple's iMovie always use 30fps, which is the default for most smartphones and digital cameras, but you might sometimes want to mix in some 60fps footage, or insert clips from commercial videos that play at different rates. In this case you'll need to let the software downsample or upsample these clips as needed, so the whole file plays at a consistent frame rate. It is technically possible to create video files where the frame rate changes from scene to scene, but these aren't widely supported by playback platforms.

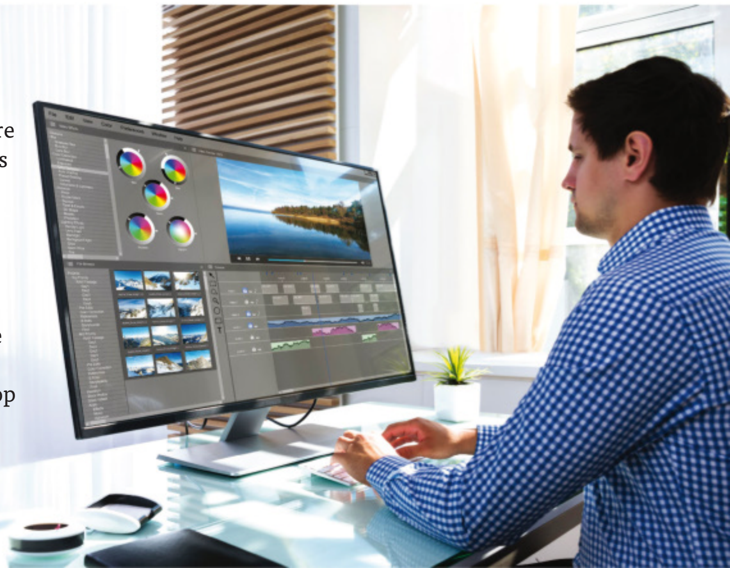
A final consideration is output resolution. The size of a video file grows rapidly as you increase the resolution – as does the amount of time taken to encode it. So if you just want to quickly share a selfie video on social media, you might choose to use 480p or 720p, and reserve higher resolutions for more cinematic creations. Nowadays it's generally assumed that any video file, regardless of the resolution, will be in a 16:9 aspect ratio, but you can still use the older 4:3 format if you prefer, or a wider shape; the player will either resize to fit your footage, or play it with black bars along the sides or the top and bottom.

The different codecs

So, back to the central question: if you have a choice of codecs, which should you use, and which settings should you apply? There are numerous legacy codecs floating around that programs still support, such as CinePak, DivX, MJPEG and RealVideo. There are also a few open-source options, such as AV1 and VP9. For modern standards of quality and compatibility, however, there are only three codecs you really need to know about.

H.264 – also known as Advanced Video Coding, or AVC for short – is the industry standard for distributing video. It's been around since 2004, when it was chosen as a default codec for Blu-ray discs; it's now widely used by streaming services and shows no sign of becoming obsolete any time soon. The latest revisions support resolutions up to 8K, with 14-bit colour and frame rates of up to 600fps. H.264 achieves high-quality results at reasonable bit rates by using techniques such as compressing data based on the content of previous frames as well as the current one, and only encoding parts of the image that are actually changing from frame to frame.

Then there's H.265, which, as the name suggests, was designed as a successor to H.264. Introduced in 2013, it's also known as High-Efficiency Video Coding, or just HEVC, because of its ability to produce video files of similar quality to H.264 at around half the file size – or twice the quality for a given file size. It achieves this by using similar compression techniques, but with greater



BELOW Professional editors use the Apple ProRes codec to keep as much detail as possible.

flexibility to break the image up into differently sized segments, and to compress each segment with the most efficient method available. It also introduces better ways of detecting and encoding elements that move from frame to frame.

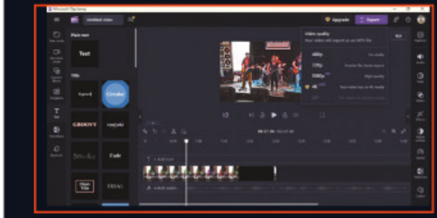
H.265 is natively supported by all major desktop and mobile operating systems, so from a consumer's point of view it's all upside. However, H.265 encoding can take as much as 20 times as long as H.264, which is one reason why many creators stick with the older standard.

Apple's ProRes codec takes a different approach to H.264 and H.265. Aimed at professionals, ProRes prioritises image quality above all else – some have gone so far as to call it "visually lossless". It also doesn't use inter-frame compression, meaning that each frame can be decoded independently, making it ideal for non-linear editing or scrubbing. These design decisions make ProRes files very large: one minute of SDR ProRes video at 1080p, running at 25fps, takes up around 1.6GB of storage. Clearly this isn't a good format for sharing or streaming, but it can be useful for storage, archival and editing.

None of these "big three" codecs is technically free. H.264 and H.265 are protected by various patents, but you don't need to pay to encode or watch video in these formats – at least not directly – as licences are covered by the suppliers of the software and services that use them. Similarly, Apple's ProRes format must be licensed for use in both software and hardware, but you won't normally need to worry about this as the company offers free codec support for both macOS and Windows. ■

Get the best from free video apps

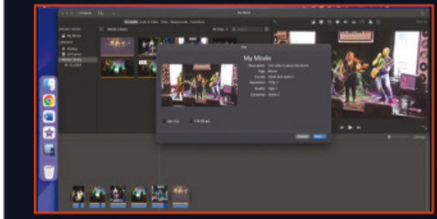
Microsoft Clipchamp



As we've noted, Clipchamp produces MP4 files using the H.264 codec at 30fps; if your source footage is in another format, it will be converted automatically when you import it. The exception is if your video is less than 15 seconds long, in which case you can export as an animated GIF.

Once you've made your edits, the "Export" button at the top-right of the main Clipchamp window brings up a dropdown letting you choose what resolution you want to export at. There are no user-selectable quality or compression settings: once you've picked a resolution, the encoding will start immediately, and you'll be given a choice of export locations including OneDrive, Google Drive, YouTube and TikTok.

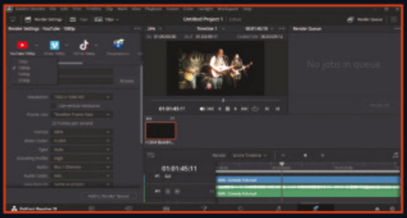
Apple iMovie



iMovie's "Share File" dialog lets you export at 540p, 720p or 1080p resolutions – although if your project doesn't include any Full HD video, that last option will be greyed out. The Low, Medium and High quality presets all use H.264 compression, with different trade-offs of quality and file size. If you select Best (ProRes), iMovie will use Apple's professional-quality codec instead, resulting in an output file that looks excellent but is around six times the size of one produced with the High quality preset.

The dialog provides a handy dynamic estimate of how large your output file will be with currently selected settings. There's no estimate of how long it will take to render, but once you've started an export you can click in the circle icon in the top-right of the application window to see an estimate of time remaining, and cancel it with the "x" icon if you don't want to wait that long.

DaVinci Resolve

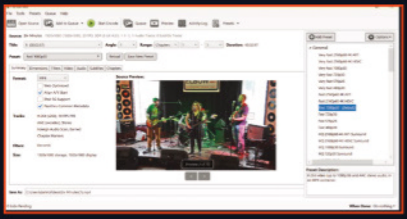


We explored DaVinci Resolve in issue 542 – you can download it for free from **blackmagicdesign.com** – and its "Deliver" module offers handy export presets for YouTube, Vimeo, TikTok and other services. They all default to a resolution of 1080p, but you can click the arrow next to them to switch to 720p, 1440p or 2160p (4K).

Below this, the Format dropdown lets you choose from a wide range of container types, including not just MP4 and QuickTime but also AVI, MKV and the professional MXF format. You can explore the codec options too, to try out H.265 and other compression types.

Don't overlook the Encoding Profile dropdown either, as this lets you choose different compression levels. The "Base" profile is for low-bandwidth targets such as mobile phones, while "Main" and "High" provide normal and top-quality output. When you're happy with your settings, click "Add to Render Queue", then click "Render Queue" at the top-right of the Deliver window to start processing.

Handbrake



The free Handbrake video-conversion tool (handbrake.fr) offers a huge range of options for transcoding video files, but you can get started easily by clicking the "Presets" button in the top toolbar. This opens a sidebar showing an extensive list of container and codec options. The "General" profiles support different resolutions and frame rates to suit almost any need.

Most of these presets use H.264, but you can easily switch to a different codec by selecting your preset, then clicking on the "Video" tab in the main window and selecting H.265 or another codec from the dropdown menu.

You can also change the desired frame rate here – potentially useful if you want to use one of the "Web Creator" presets, as these all default to 60fps.

Handbrake's other tabs include options to resample or crop the video to change its resolution, convert the audio, apply various filters and update the metadata. Once you hit the "Start Encode" button a progress display appears along the bottom of the window, including an estimated time to completion.

Wallpaper Search: - wallhaven
wallhaven.cc/search?categories=100&purity=100&atleast=3440x1440&ratios=21x9&sorting=random&order=desc&ai_art_filter=1
wallhaven
Latest
Hot
Toplist
Random
Upload
Forums
More
Search...
Register
Login
General
Anime
People
AI Art
SFW
Sketchy
≥ 3440×1440
21 × 9
Color
Random
2,723 Wallpapers found
Find more search options above!
+ At Least
Exactly
Your screen resolution is 3440 × 1440.
Ultrawide
16:9
16:10
4:3
5:4
Custom Resolution
Width
Height
AOC

There are over 1,500 Ultrawide 21:9 3440x1440 wallpapers on this site under the general tag.

PART TWO

PART 1 APPEARED IN ISSUE 542

THE ULTIMATE WINDOWS 11 INSTALL GUIDE

Install our favourite OS like *APC* veteran **Zak Storey** does it.

Ah, Windows 11, you old devil. Microsoft's latest iteration of its operating system line might be quite contentious these days, filled with advertising, data scraping, and enough bugs to make even a Tyranid Hive Fleet jealous, but it's nothing if not a consistent thread throughout our custom PC building life.

It represents the ultimate middle-ground OS – versatile and customisable enough to outpace the very best of MacOS, yet with more than enough compatibility and stability to give any Linux distro a run for its money. If you just want to get an install up and running quickly, tailored just how you like it, and compatible with 99.9 percent of all the programs out there, then Windows is the place to be.

That said, it's not without its pitfalls. In our anecdotal experience, we often find that Windows OS seems to degrade over time. Performance falters, registry keys become corrupt, driver updates fail, and unnecessary background processes and programs hog resources that would be better used elsewhere. It's almost become a *APC* tenet, but seriously, if you're not already, you should consider reinstalling your Windows OS every three to six months. It's on the same level as 'it's probably memory' and 'have you tried turning it off and on again' in our most repeated PC troubleshooting phrases.

Not only will you get a clean install, it'll also give you the opportunity to throw out any old programs and keep everything running nice and smoothly in the meantime.

There are also a lot of customisation tweaks you can do with the modern form of Windows. As always, your own install will inevitably be unique to you, designed for your needs, but today we're going to share with you just how we here at *APC* install Windows on everything from our personal machines to test systems and beyond. We'll cover our general install process, what tweaks we perform, how we configure it to maximise its utility, and tips on how to streamline its efficiency, leaving you with an ultra-slick desktop that's perfect for anything you throw at it. Let's dive back in, shall we?

APC'S TIPS AND TWEAKS

HOW TO FINE-TUNE YOUR DESKTOP EXPERIENCE

TWEAK Armoury Crate, DriverHub, et al

With Windows installed and your network connected (see Part One last issue), a variety of programs will start popping up with auto-installers. Asus, for example, will have DriverHub and Armoury Crate. DriverHub is incredibly useful, as it will point you toward missing installs and new versions of any chipset or drivers you're missing.

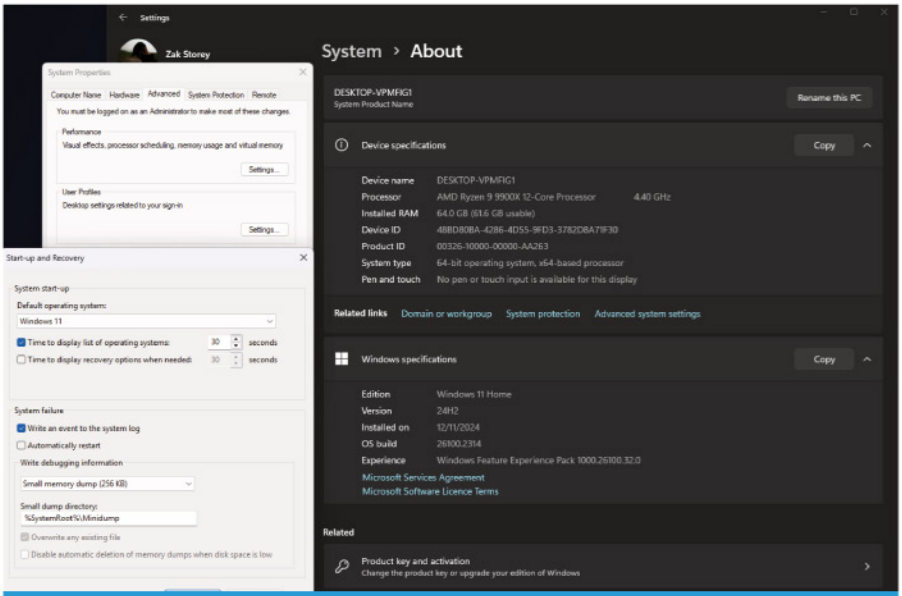
That said, if you hit 'Install all', it will also install a bunch of crud that we don't want, such as Norton 360 Antivirus, AIDA64, and other superfluous programs we'll only end up uninstalling. The same goes for MSI and Gigabyte, so be wary no matter what your motherboard.

Now that we've done the majority of the legwork on our driver updates and clean install process, it's time to tighten up the system a bit and proceed with a few quick fixes. The first thing is going to be updating the time.

TIP Time dilation

For whatever reason, the time-zone settings are always buggy with your first install. Head to the Start menu, type 'Date and Time', and select the top option. Once in the Date & Time menu, uncheck and recheck 'Set the time zone automatically' and 'Set the time automatically' below it.

This should then force Windows to sync with the internet and your time zone/IP, and get the right time (this is important for Windows updates and certain two-factor authentication methods).


Settings
Zak Storey
System Properties
Computer Name
Hardware
Advanced
System Protection
Remote
Settings...
Settings...
System › About
Rename this PC
Copy
Copy
Related
Product key and activation
Change the product key or upgrade your edition of Windows

You must be logged on as an Administrator to make most of these changes.

Performance: Visual effects, processor scheduling, memory usage and virtual memory

User Profiles: Desktop settings related to your sign-in

Start-up and Recovery

System start-up

Default operating system: Windows 11

☑ Time to display list of operating systems: 30 seconds

☐ Time to display recovery options when needed: 30 seconds

System failure

☑ Write an event to the system log

☐ Automatically restart

Write debugging information: Small memory dump (256 KB)

Small dump directory: %SystemRoot%\Minidump

☑ Overwrite any existing file

☐ Disable automatic deletion of memory dumps when disk space is low

DESKTOP-VPMFIG1
System Product Name

Device specifications

Device name	DESKTOP-VPMFIG1
Processor	AMD Ryzen 9 9900X 12-Core Processor 4.40 GHz
Installed RAM	64.0 GB (61.6 GB usable)
Device ID	48BD80BA-4286-4D55-9FD3-3782D8A71F30
Product ID	00326-10000-00000-AA263
System type	64-bit operating system, x64-based processor
Pen and touch	No pen or touch input is available for this display

Related links: Domain or workgroup | System protection | Advanced system settings

Windows specifications

Edition	Windows 11 Home
Version	24H2
Installed on	12/11/2024
OS build	26100.2314
Experience	Windows Feature Experience Pack 1000.26100.32.0

Microsoft Services Agreement
Microsoft Software Licence Terms

Stop those pesky system crash restarts.

TWEAK PowerPlan edits

Are you vain like us? Do you like showing off your beautiful PC when you've got guests, or do you just like to admire your desktop's beauty as you're using it? Then a quick PowerPlan edit is for you. Go to the Start menu, type 'Edit PowerPlan', click the option, change 'Put the

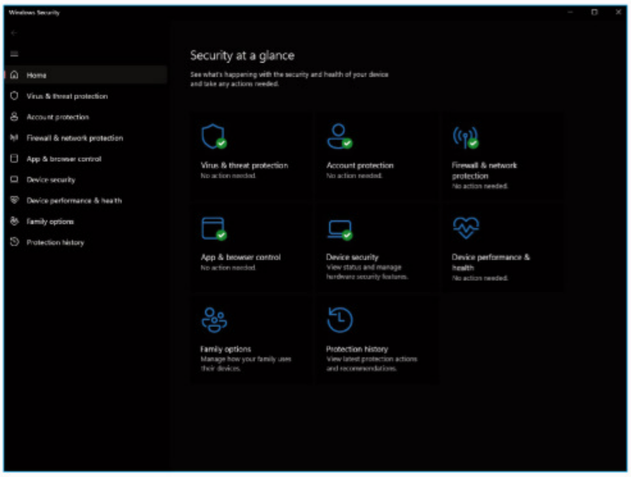
THE BEST ANTIVIRUS

It's Windows Defender. It just is. No, honestly, the best defense you have against bad actors on the internet and other malicious code is good internet practices. Don't open attachments from random emails, click dodgy links, or download suspect programs, and you'll be golden. If the worst comes to the worst, you can just flatten your system and reinstall your OS.

Most aftermarket antivirus programs cause all manner of conflicts and issues on many of the PCs we've worked with over the years, sucking up valuable system resources, causing conflicts, and even outright stopping all manner of programs from running efficiently (even some of our benchmarking programs). We've seen them delete system files, parts of programs, and other benign applications on a whim, stop them from running, or crashing entire systems after Windows updates. The reality is that 99 percent of the time, they're just not worth running.

Sure, Malwarebytes is useful every now and then for a quick sweep, but Windows Defender is one of the most up-to-date and unobtrusive antivirus programs out there, and it's built into your operating system, doesn't take up valuable resources, and generally just works.

You do not need aftermarket antivirus, so save yourself the subscription fee, and grab a VPN instead.


Windows Security
Home
Virus & threat protection
Account protection
Firewall & network protection
App & browser control
Device security
Device performance & health
Family options
Protection history
Security at a glance
Virus & threat protection
Account protection
Firewall & network protection
App & browser control
Device security
Device performance & health
Family options
Protection history

See what's happening with the security and health of your device and take any actions needed.

Virus & threat protection: No action needed.

Account protection: No action needed.

Firewall & network protection: No action needed.

App & browser control: No action needed.

Device security: View status and manage hardware security features.

Device performance & health: No action needed.

Family options: Manage how your family uses their devices.

Protection history: View latest protection actions and recommendations.

computer to sleep' to Never, and 'Turn of the display' to 3 Hours. Now, you can enjoy your rig for a little longer. Just remember to turn it off when you're done. This is also really useful if you want to download programs and games overnight.

TIP

Stop error restarts

Have you ever shut down your system before going to sleep with updates, and woke up to the thing still turned on in the morning? Yes, it's a pet peeve of ours, too. This is to do with how Windows manages its system failures, where it will automatically restart if something goes wrong. This can be as simple as an update taking too long, or failing and fixing itself on the restart. To stop this, go to Settings, then System, then About. Once here, click the 'Advanced system settings' option. Then, under 'Start-up and Recovery', hit the 'Settings...' button. Under 'System failure', uncheck 'Automatically Restart' and hit 'OK', and you'll be good to go.

TIP

Tidy the taskbar

We're not fans of that centralised Start menu – it's just not for us. Nor are we fans of all the stuff that Microsoft has chucked on here, too. Right-click the task bar, and open 'Taskbar Settings'. If you're like us and prefer to use keyboard shortcuts, disable 'Task view' and 'Widgets', and hide the 'Search' option. Then, click the 'Taskbar behaviors' tab, and choose 'Left' for taskbar alignment.

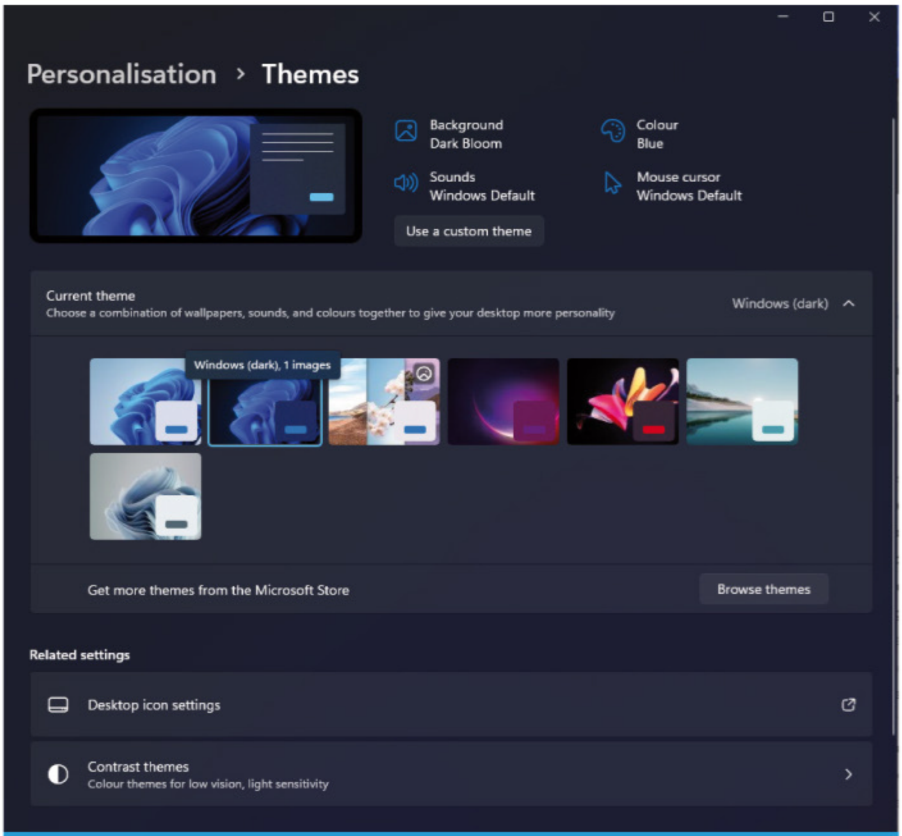
We will also be removing a few of the fluff programs that Windows chucks on here. Right-click Copilot and unpin it, along with the Microsoft Store. You can leave Edge for the time being, as we'll need it to unceremoniously install Google Chrome and others in a moment.

TWEAK

Theme and mouse settings

Right-click Desktop, and hit Personalisation. Go to Themes, and select the second most dark theme for a nice, clean dark mode option for your desktop. We'll be changing the wallpaper later, but this just brings the intensity of those bright screens down when we're working on projects late at night. While we're here, we're also going to adjust our mouse cursor. Select the 'Mouse cursor' option on the top right. This will open an old-school 'Pointers' menu.

Here, we're going to choose the 'Windows Black (system scheme)' for our mouse pointer. This might sound a bit insane, but it makes spotting the mouse on larger screen setups far easier. This is particularly useful if you're using ultra-wide or 4K panels in conjunction. The number of times we've lost a white mouse pointer on those things is troubling.



Personalisation › Themes

Background
Dark Bloom

Colour
Blue

Sounds
Windows Default

Mouse cursor
Windows Default

Use a custom theme

Current theme
Choose a combination of wallpapers, sounds, and colours together to give your desktop more personality

Windows (dark)

Windows (dark), 1 images

Get more themes from the Microsoft Store

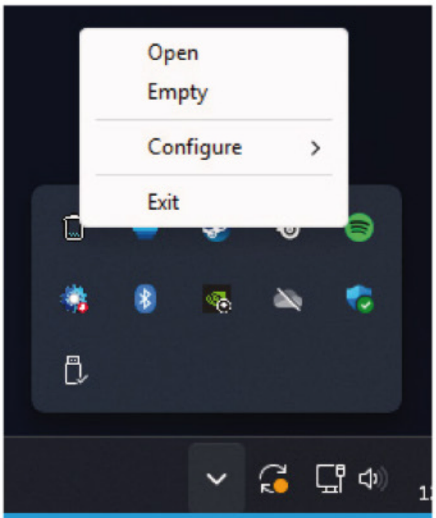
Browse themes

Related settings

Desktop icon settings

Contrast themes
Colour themes for low vision, light sensitivity

There's so much more to customisation here than you realise.



It's a simple and elegant solution for your recycling bin needs.

TIP

Desktop icons and minibin

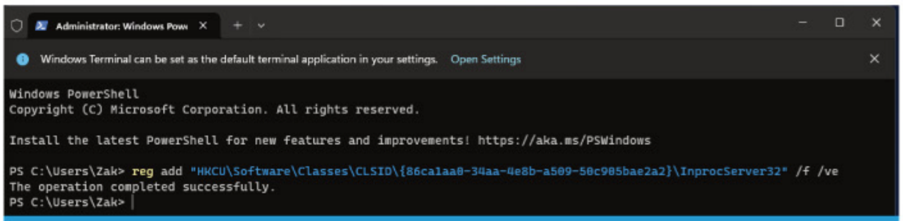
While we're still in the Themes setting, select 'Desktop icon settings' and uncheck the 'Recycle Bin' desktop icon. We're going to be replacing our recycling bin with a third-party program that makes everything a lot slicker. Hit Apply – this will hide it from your desktop.

Then, head to Google and search 'Minibin Download'. Go to Major Geeks (**www.majorgeeks.com**), and download MiniBin 6.6.0.0. Run and install it, and a bin icon will appear in your hidden icons menu on the bottom right. Right-click it, select 'Configure', then 'Icon double-click action', and ensure that it's set to 'Open' rather than 'Empty'. Delete the programs and links off your desktop, and you should have a completely empty setup.

TIP

Monitor tweaks

We've all fallen foul of this at one point or another – you have that 240Hz refresh rate monitor, but accidentally use it at 60Hz for a good long while. Head to 'Settings', then 'System', then 'Display', select the monitor you want to configure, scroll down to 'Advanced display', then 'Choose a refresh rate', and select the highest refresh rate you can. Just a heads


Administrator: Windows Pow
Windows Terminal can be set as the default terminal application in your settings.
Open Settings

```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\Zak> reg add "HKCU\Software\Classes\CLSID\{86ca1aa0-34aa-4e8b-a509-50c905bae2a2}\InprocServer32" /f /ve
The operation completed successfully.
PS C:\Users\Zak> |
```

There's nothing like a bit of regedit in PowerShell to get a decent right click menu back.

up: you won't be able to do this prior to installing your graphics driver.

If you're running twin monitors at odd angles like we are, another setting to turn off here in 'Multiple displays' is 'ease cursor movement between displays'. This makes it so you can finely calibrate the gap and movement path for your mouse cursor to pass between the two displays, by shifting them in the window above. This is insanely useful if you like snapping programs to each side of the screen.

TWEAK

Night Light

Another neat feature is Windows' built-in Night Light solution. To make things a little bit more tolerable on your eyes during low-light situations, you can get Windows to naturally increase the warmth of your displays as the sunsets, and brighten them on Sunrise.

Click the Start menu, then type 'Night Light' and go into the settings. Check the box to allow Night Light to schedule based on sunset and sunrise, then adjust the strength to your liking, and you'll be golden – literally (well, at least, your screen will be).

TIP

Right-click Power menu

When it comes to the right-click menu in general, hitting 'More options' all the time gets pretty tiresome. Fortunately, you can disable the first menu and go directly to that Power menu instead if you want to with every right click. To do this, go to the Start menu and right-click it, then select ;Terminal (admin)'. Once Windows PowerShell has opened up, type in the following, and hit Enter:

"HKCU\Software\Classes\CLSID\{86ca1aa0-34aa-4e8b-a509-50c905bae2a2}\InprocServer32" /f /ve

Once PowerShell registers that the operation completed successfully, go to Task Manager, find Windows Explorer, and restart it. You'll now have the right-click menu from Windows 10 back.

TIP

Programs and Ninite

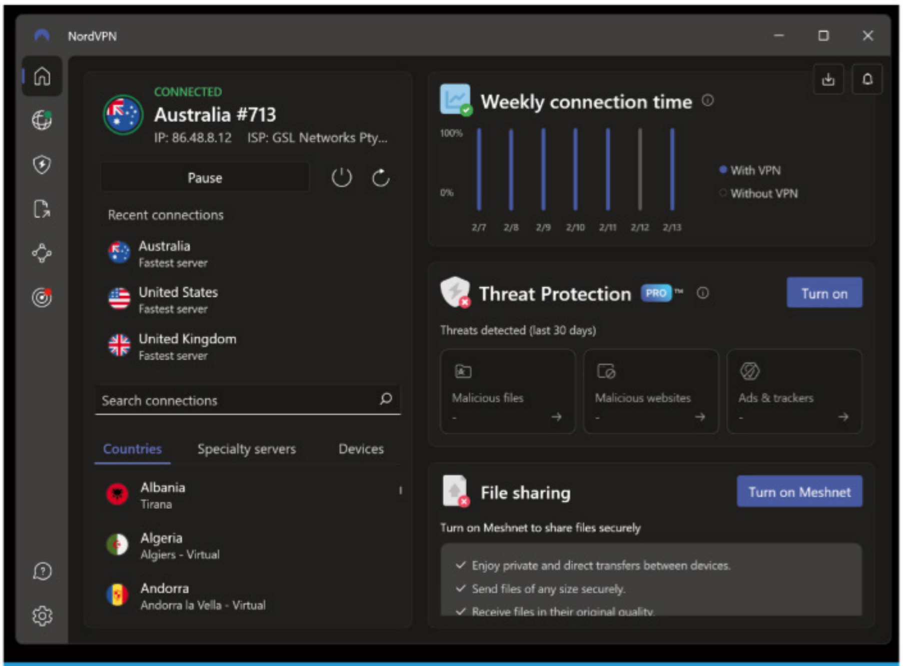
With our arsenal of quick fixes in place, it's now time to get Ninite in. Open up Edge, and (once you're past the initial interrogation it likes to put you through) head to **ninite.com**. Here, we're going to download all the programs we need. For us, we typically install Chrome, Firefox (as a back-up browser), Zoom, Discord, Skype, WinRAR, Spotify, Notepad++, and Steam. Let that run, and download everything you need.

With that done, log in to Chrome and enable Sync. This will pull all your Google Chrome plugins, settings, cookies, and more across, saving you a ton of time in the process. We're also going to start installing all our other programs. In our case, that will be our benchmarking tools (CrystalDiskMark, Cinebench, and *Final Fantasy XIV* tests are all fantastic free benchmarking options), along with HWMonitor, Adobe CC, all the game launchers we need, our batch of Elgato programs, and whatever else we'll need day-to-day.

We're also going to take the opportunity to log in to all the programs and sites that we need to, and install our VPN of choice. The vast majority of VPNs out there these days are top-tier – we highly recommend that you grab one for your internet safety, whether that's ExpressVPN, NordVPN, Surfshark, Proton VPN, or something else. Find the one with the best deal (there are almost always offers), and get that thing installed and loading up with Windows minimised every time. With NordVPN, we ensure that it auto-connects with an internet kill switch and starts with Windows on startup minimised.

We also log in to Skype and Discord, and set their options to not start or load with Windows launch (they're both notorious for ignoring startup menu commands), as we only need them occasionally. Next, we're going to want to log in to Steam and find our D: drive games. To do that, go to 'Steam' in the top left, 'Settings', then 'Storage', and add a new drive. Select your 'Local Drive (D:)', and Steam will then scan and identify any installed games there too. This also works with EA and Battle.net. Sadly, Epic will automatically redownload games no matter what, and Ubisoft's launcher takes an age to verify the files, but technically doesn't redownload.

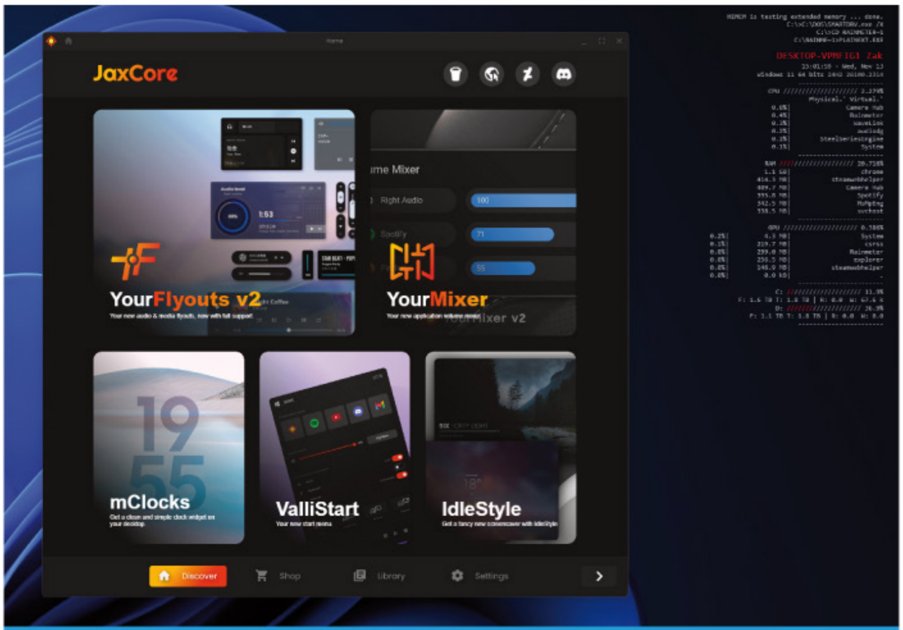
Pin the programs you need to your taskbar, or your start menu, and we're close to being finished.


NordVPN
CONNECTED
Australia #713
IP: 86.48.8.12 ISP: GSL Networks Pty...
Pause
Recent connections
Australia
Fastest server
United States
Fastest server
United Kingdom
Fastest server
Search connections
Countries
Specialty servers
Devices
Albania
Tirana
Algeria
Algiers - Virtual
Andorra
Andorra la Vella - Virtual
Weekly connection time
100%
0%
2/7
2/8
2/9
2/10
2/11
2/12
2/13
With VPN
Without VPN
Threat Protection
PRO
Turn on
Threats detected (last 30 days)
Malicious files
Malicious websites
Ads & trackers
File sharing
Turn on Meshnet

Turn on Meshnet to share files securely

✓ Enjoy private and direct transfers between devices.
✓ Send files of any size securely.
✓ Receive files in their original quality.

Ensuring you have a VPN correctly set up is a pivotal privacy measure.



JaxCore and Rainmeter help add a bit of pizazz to your desktop life.

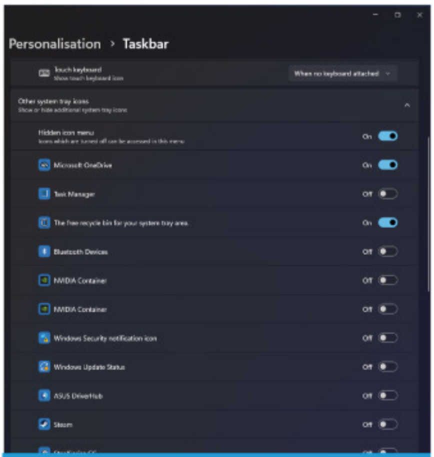
TWEAK

Rainmeter & JaxCore

We've got a final few tweaks to really make our desktop shine. First up is getting Rainmeter installed. Rainmeter allows you to posit third-party widgets on your desktop. These are insanely useful, as Windows doesn't, for some reason, have a suitable solution for this just yet. Head to rainmeter.net, and download the latest release build.

As standard, it comes with a fairly generic skin. You can unload those widgets by right-clicking them and selecting the expanded option. Double-click the Rainmeter icon in your icons tray, and you'll find all the loaded skins as well.

In our case, however, we're going to be using a widget suite called JaxCore to provide us with what we need (in this case, system monitoring, clocks, and media flyouts). Head to **jaxcore.app**, and download the latest version.



Personalisation › Taskbar

Touch keyboard
Show touch keyboard icon
When no keyboard attached

Other system tray icons
Show or hide additional system tray icons

Hidden icon menu
Icons which are turned off can be accessed in this menu
On

Microsoft OneDrive On
Task Manager Off
The free recycle bin for your system tray area. On
Bluetooth Devices Off
NVIDIA Container Off
NVIDIA Container Off
Windows Security notification icon Off
Windows Update Status Off
ASUS DriverHub Off
Steam Off

It's well worth dropping MiniBin and your VPN onto your taskbar icons list.

It will run a PowerShell script to install. Once in, you want to install Plainext, YourFlyouts, and ModularClocks. There's a whole host of configuration you can do here, all of which is fairly self-explanatory. There are a number of Rainmeter skins that look a treat, too, if you're not a fan of JaxCore's work. Check out the official site, Discord Art, and Reddit for those.

We're also going to pair this with some beautiful wallpaper. There are a few places to get decent wallpaper from, but we love wallhaven.cc the most. You can find all manner of wallpapers here (there are around 1.2 million wallpapers). Click Random at the top, then deselect the tabs you don't want to see. What's unique about Wallhaven is that you can select a number of filters, including resolution and aspect ratio, then filter them appropriately. Find the right settings for your screen, then search a keyword, or scroll down the list and find some truly top-tier wallpapers.

TWEAK

Final taskbar tweaks and startup speed

With all of our programs installed and ready to go, we're going to have a final pass at our taskbar icons. Head back to Taskbar settings by right-clicking it and hitting Settings, then click the 'Other system tray icons' menu. Here, you'll find a list of all the programs you have running that are currently hidden. You can toggle them on or off to appear on the bottom right of the taskbar. We highly recommend toggling Minibin and your VPN of choice here, as it makes it far more easy to access them if you do so.

With that, we're then going to task a final pass at our start-up programs as well. Search 'Startup' in the same settings menu, and it'll take you to a list of all the apps you have installed. Go down the list, and disable anything that's intrusive or you don't always need on launch. Then go into Task Manager, find the same menu, and ensure you've not missed anything. With that, you'll finally be finished. Welcome to your *APC*-approved, slick, and super-clean desktop. ■

HOW DO YOU USE THIS THING?

Simply put, your desktop is your workspace. This is where files you're working with or on during the day or at that moment should be placed – a temporary space while you complete projects. Once you're wrapped up with them, delete them, upload them, back them up, or clean them off your desktop.

The taskbar is where your most frequently used programs are found. These can include games – Spotify, web browsers, Photoshop, the works. The less you have on here, the better. The programs in your Start menu should be less frequently used programs, but still mission-critical. In our case, these are system monitoring tools, benchmarks, audio and camera control, and general setting programs. The hidden taskbar icons are there for everything else.

Game launchers are, ironically, fantastic clean-up tools, too. Instead of having 14 different titles on your taskbar, desktop, or start menu, they're all held in a single launcher. Open that up, and use it that way.

Alternatively, Windows search is your friend. Need a program, but can't remember where you put it? Click the Start menu, and start typing to find it. It's a super-quick and easy way to discover any and all programs you might need.

PC BUILDER

From the front lines of the Australian PC market

System news

Looking into a Black Well of expensive GPUs? Mark Williams hopes Navi 48 will be the light at the end of the tunnel.

Nvidia's hotly anticipated RTX 5000 series of graphics cards finally broke cover recently, and hit store shelves only to near instantly sell out. While not uncommon for new graphics cards, the extent of what's happening seems unprecedented or at the very least as bad as what happened during COVID. Except back then it was all about demand out-stripping supply, currently, it's obviously supply not being high enough at launch with many questioning if this was a paper launch.

New graphics cards will always have early adopters jumping on board to buy them, but with the RTX 5090 so far having the only real performance bump over the previous generation, you'd think the RTX 5080 would have far less demand given that it only performs around 10% faster than the RTX 4080 and for the first time in history, isn't equal or faster to Nvidia's previous gen tier above card; the RTX 4090.

So, while quicker, it already has lacklustre performance over the RTX 4000 series. Combine that with higher prices and you begin to wonder who would be buy these at the current prices. The RTX 4080 Supers were going for around $1,700 to $1,900 before, now the RTX 5080 starts at $2,000 and balloons out past $2,800 for the top models, yet they're all sold out.

The top tier RTX 5090 fares no better, but at least appears to be starting where the RTX 4090 left off, starting at an eye watering $4,000 with some extreme models topping out above $5,500.

Supply of these cards did exist, as people have been quick to relist these on the second-hand market at a substantial markup to turn a quick profit. The scalped card markups have even led to card makers upping their MSRPs to get in on the action.

Word is the RTX 5080 was in greater supply at launch than the RTX 5090, and as such when more flow in we should see those back in stock sooner. Much of the supply restrictions so far has been placed on the timing of the launch with the Chinese New Year happening right at launch, with many factories and workers taking several weeks to a month off work, it could simply mean once workers are back at the factories supply of the cards will once again flow and start to alleviate initial demand.

Until then many are looking forward to the RTX 5070 and Ti cards to hit and satiate the mainstream customers. Those are due to launch early March alongside AMD's RX 9070 and XT cards, which is being touted by AMD as the new value king this generation. Be that due to aggressive pricing or competitive performance, or if we're lucky both, something AMD should easily hit if early indications of the RTX 5070 Ti's MSRP of US$750 is already being ignored by early listings starting at US$1,000.

Of course, none of it matters if you can't buy anything, simply having stock on shelves could be all that's required to win this generation. The next few months will be a good guide on how the rest of this generation over the next few years will shape up, both from a pricing and availability standpoint. With any luck, the fierce competition in the mid-range will be good for consumers wallets. ■

Mark Williams is an IT professional with a strong interest in voiding warranties.

Market Watch

A sampling of PC systems available this month

PHOTECH P20C i7 RTX40

$2,501
tinyurl.com/APC543pho

If you're looking to get into PC gaming without breaking the bank, this is a great place to start. Admittedly it's based on an outdated platform, though the 12700F was no slouch in its time and if you're not asking the world of it will cope very well with any games and productivity apps you could throw at it, certainly more so than AMD counterparts of the same era with less cores.

The RTX 4070 is a couple years old now but is still very capable of playing newer titles so long as 1080p or 1440p are your target resolutions. Storage, memory and PSU are all well matched making this quite the satisfactory rig to consider in the current challenging PC ecosystem.

CPU Intel Core i7-12700F; **COOLER** Thermalright Burst Assassin 120; **MOTHERBOARD** Asus TUF Gaming B760-Plus WIFI; **GRAPHICS** GeForce RTX 4070 12G; **MEMORY** 32GB Klevv FIT V 6000MHz CL32 DDR5; **STORAGE** 1TB Kingston KC3000 Gen4 M.2 NVMe SSD; **POWER SUPPLY** MSI MAG A750BN PCIE5 750W; **CASE** Antec P20C.

MWAVE KATANA BLADE

$2,499
tinyurl.com/APC543mwv

Coming in at the same price as the Photech system, this goes the AM4 route, slotting a Ryzen 7 5700X CPU. Still very serviceable for today's needs though not as snappy as the 12700F in the other system. Being AM4 though you have the potential to upgrade this rig later with an X3D chip to stay current. The GPU her is slightly faster by less than 10% though will be weaker in ray-traced titles.

The other difference worth mentioning is the move up to a 2TB SSD. Given the CPU upgrade potential, slightly stronger GPU and larger SSD, this is the one to pick of the two if you're not needing raw CPU performance for productivity work.

CPU AMD Ryzen 7 5700X; **COOLER** DeepCool AG400 ARGB; **MOTHERBOARD** Asus Prime B550M-A WIFI II; **GRAPHICS** Asus Radeon RX 7800 XT Dual OC Edition 16GB; **MEMORY** 32GB Kingston Fury Beast RGB DDR4 3600MHz; **STORAGE** 2TB Crucial P3 Plus PCIe 4.0 NVMe SSD; **POWER SUPPLY** XPG Kyber 750W; **CASE** Antec CX200M Elite.

PC CASE GEAR ASTRAL 5080

$4,999
tinyurl.com/APC543pcg

Touting the new RTX 5080, this system is for serious gamers. While the price is also serious, it's kept in check by using a reasonably value-oriented CPU that will keep up with the task at hand, just don't expect blazing results at high refresh rates in eSports titles. This system is best suited to those that like to turn up the graphics details in games.

With lots of cooling available, overclocking would be worth dabbling with. Memory, storage and the PSU are all what you'd expect at this price as with the motherboard chipset features. Highly worth considering if you want a new system with the latest generation parts in it.

CPU Intel Core Ultra 7 265K; **COOLER** Arctic Liquid Freezer III 360mm ARGB AIO; **MOTHERBOARD** Gigabyte Z890 Aorus Elite WIFI7; **GRAPHICS** Gigabyte GeForce RTX 5080 Gaming OC GDDR7 16GB; **MEMORY** 32GB Lexar ARES RGB CL32 6400MHz DDR5; **STORAGE** 2TB Lexar NQ790 NVMe Gen4 SSD; **POWER SUPPLY** Kolink 850W; **CASE** Kolink GSI SmartAssembly ARGB Mesh E-ATX.

AFTERSHOCK PC ULTRACORE

$4,999
tinyurl.com/APC543aft

Hitting the same price mark as the PC Case Gear system, this goes the AMD route with the gamer friendly 7800X3D CPU. Similar graphics cards put them on par but with the X3D CPU this system sacrifices productivity grunt for gaming prowess, meaning high refresh rate gaming will be much easier on this system.

This has a larger capacity power supply, so future upgrades can easily accommodate higher performance parts.

Given the white theme of the system and the default GPU being standard blacks and grey, it would be well worth opting at checkout for a white graphics card so the whole system has a cohesive theme, though that may come at a substantial price premium.

CPU AMD Ryzen 7 7800X3D; **COOLER** Aftershock Glacier Mirror 360mm AIO; **MOTHERBOARD** Gigabyte X870 Aorus Elite Ice Wi-Fi; **GRAPHICS** MSI RTX 5080 Ventus 3X OC 16GB; **MEMORY** 32GB Lexar Thor RGB 6000MHz; **STORAGE** 2TB Gen4 Kingston SNV3S; **POWER SUPPLY** Inwin 1050W; **CASE** Lian Li O11D Evo XL.

Blueprints

Value- and performance-driven hypothetical builds

Budget. A perfect balance between price and performance.

It feels like every month, we're bracing ourselves for a new set of hardware launches. With CES finally landing, we're being graced with a whole bunch of them all at once. New AMD and Nvidia cards, and new Intel GPUs have launched roughly at the same time, although admittedly the Intel ones a little sooner.

That said, right now it's only the 5080 and 5090 cards we have tested so far, we're still awaiting review samples and units to land with us, to figure out how exactly the lower end cards tick. Nvidia has already announced that the RTX 5070 will deliver just as much performance as an RTX 4090, but at almost one quarter of the cost. Whether that's true remains to be seen.

The long and the short of that? Unless you find an astonishingly good deal, it's worth avoiding picking up a graphics card until the official reviews launch (at which point we'll have rejigged our Blueprints segment here as well).

With that in mind, we're changing a lot in our budget builds, predominantly in the land of AMD, finally dropping the Ryzen 5 7600 and bringing in a 9600X, plus a new B850 board. That has lifted the cost of our build up quite a bit, not only as the motherboard and CPU bumped up the cost, but also as we needed to add a standalone CPU cooler. For our red build, we still slid under $1,700, but only barely, with the total cost shooting up by $221 on last month.

Not to leave our Intel setup out in the dark, we also added the same be quiet! Pure Rock Slim 2 cooler here. Yet, aside from that, we're still hanging on to the Core i5 14400F, as it's just such a good deal right now.

As for a good budget GPU, this one we can say with confidence: get an Intel Arc B580. Right now, it's just the best budget card money can buy, if you can find one in stock.

AMD BUILD **Approximate Price $1,636**

Case		Phanteks XT View	$129
PSU		Thermaltake Litepower Gen3 650W 80+	$79
Mobo	NEW	**Gigabyte B850 Eagle WiFi6E ATX**	**$349**
CPU	NEW	**AMD Ryzen 5 9600X**	**$339**
Cooler	NEW	**be quiet! Pure Rock Slim 2**	**$35**
GPU		Sparkle ORC OC A750 8GB	$349
RAM		Team T-Force Vulcan Alpha 32GB (2x16GB) 6000MHz CL38 DDR5	$155
SSD		500GB Crucial P3 Plus PCIe 4.0 M.2	$56
SSD		1TB Klevv CRAS C910 PCIe 4.0 M.2	$85
OS		**Windows 11 Home 64-bit OEM**	**$60**

Intel BUILD **Approximate Price $1,526**

Case		Phanteks XT View	$129
PSU		Thermaltake Litepower Gen3 650W 80+	$79
Mobo	NEW	**MSI Pro Z790-S WiFi ATX**	**$285**
CPU		Intel Core i5-14400F	$249
Cooler	NEW	**be quiet! Pure Rock Slim 2**	**$35**
GPU		Gigabyte Radeon RX 7600 Gaming OC	$429
RAM		Team T-Force Vulcan Alpha 32GB (2x16GB) 6000MHz CL38 DDR5	$155
SSD		500GB Crucial P3 Plus PCIe 4.0 M.2	$56
SSD		1TB Klevv CRAS C910 PCIe 4.0 M.2	$85
OS	NEW	**Windows 11 Home 64-bit OEM**	**$60**

AMD BUILD Approximate Price $2,593

Case		Hyte Y40 ATX Mid Tower	$179
PSU		850W Thermaltake Toughpower GF1 2024 80+ Gold	$135
Mobo		Gigabyte X870 Eagle WIFI7	$439
CPU		AMD Ryzen 7 9700X	$559
Cooler		Noctua U12S chromax.black	$140
GPU	NEW	**Asus Dual OC RX 7700 XT 12GB**	**$629**
RAM		32GB (2x 16GB) TeamGroup T-Create Expert @ 6,400 C32	$165
SSD		1TB Lexar NM790 M.2 PCIe 4.0 SSD	$119
SSD		2TB Silicon Power UD90 M.2 PCIe 4.0 SSD	$168
OS	NEW	**Windows 11 Home 64-bit OEM**	**$60**

Intel BUILD Approximate Price $2,652

Case		Hyte Y40 ATX Mid Tower	$179
PSU		850W Thermaltake Toughpower GF1 2024 80+ Gold	$135
Mobo		MSI Pro Z790-P WiFi	$329
CPU		Intel Core i7-14700F	$499
Cooler		Cooler Master MasterLiquid ML360L ARGB V2 360mm AIO	$135
GPU	NEW	**MSI Ventus 2X OC RTX 4070 12GB**	**$849**
RAM		32GB (2x 16GB) Silicon Power Xpower Zenith Gaming @ 6,000 C30	$179
SSD		1TB Lexar NM790 M.2 PCIe 4.0 SSD	$168
SSD		2TB Silicon Power UD90 M.2 PCIe 4.0 SSD	$168
OS	NEW	**Windows 11 Home 64-bit OEM**	**$60**

Mid-range. A game-ready machine that can also handle demanding work.

On the mid-range front, all of our systems have remained fairly stable this time around. Team Red decreased by a total of $186 thanks to a price drop for the Hyte Y40, plus some other savings here and there (don't worry, we're getting around to that OS swap).

Unfortunately, there has been a slight price increase in the RX 7700 XT's (lightly in light of the new AMD cards launching in the next few months), which did impact the overall pricing a bit more than we'd like, but it's a comfortable build for those looking for a mid-range system. Again, given we're due new GPUs, it's definitely worth waiting for those cards to land instead.

As for our Intel system, you'll spot that not a single thing has changed. The 14700F remains the mid-range chip of choice at $499, and the overall pricing has stayed relatively stable, with ups and downs here and there leading to a grand total of costs going down by a mere $61. That was mostly down to all of the RTX 4070s jumping in price by $20 on last month. Simply put, you just can't find an RTX 4070 for less than $899 right now.

Lastly, we've re-checked consistent pricing for Windows 11 OEM (one-time use) keys, and they've seen a marked drop in the last year or so. Combine that with the fact that this year, Microsoft is stopping its support for its "last ever operating system," Windows 10, no longer producing software updates, tech assistance, or security fixes – we're all going to have to be on Windows 11. Just make sure you pick up your OEM key from a reputable vendor. You're far better off grabbing a full-fat Windows license and tying it to your Microsoft account. It might cost more, but it's helpful for those rapid reinstalls we're fans of. We also asked Google Gemini what we should do; apparently, you can 'run Windows 10 without updates' (not recommended) or 'buy a new PC'. So there you go, the AI gods have spoken.

High-end. The ultimate do-anything-with-ease PC.

As with our budget builds, in the land of the Turbo rigs, the changes are equally as potent for Team Red. We've finally bit the bullet and once again jumped up to AMD's latest generation and the flagship Ryzen 9 9950X. Complete with 16 cores, 32 threads, 64MB of L3 cache, and a whopping 5.7GHz clock speed, this thing is an absolute monster at multi-threaded apps, and isn't exactly a slouch in the single-core/ gaming department, either.

Again, though, this has led to some significant cost increases, with a whopping $180 over last month's 7950X. To be fair, the 7950X is now in very short supply anyway, so that was a necessary sacrifice, to be quite frank.

Other changes include a new PSU in the form of EVGA's SuperNOVA 1000 P5, as all of Super Flower's Leadex units had jumped up in price, and that's about it. One thing to note: the new RTX 5090 will draw 575W of power, with a 1000W PSU recommended. They're still using the same 600W 12HVPWR solution (RTX 4090 was limited to 450W), but given how power hungry the last generation was, it may be advisable to go for an even higher watt PSU, although we can't confirm that 100 percent just yet.

For our Intel rig, we're still sitting on that 14th gen for the time being, and again, changes are fairly minimal across the whole rig, the only exception being that GPU. We've swapped the Zotac card for this stunning MSI deal, as the Zotac card had shot up by (hang on a minute, we've got the note here somewhere), ah yes, that's it, $150. Boy, they do know how to make this job easy.

Despite all the changes, then, our AMD build has gone up in price by a svelte $140, and our Intel build has dropped by $30, but again, hold on for those new GPUs.

> "AMD's latest generation and the flagship Ryzen 9 9950X. Complete with 16 cores, 32 threads, 64MB of L3 cache, and a whopping 5.7GHz clock speed, this thing is an absolute monster at multi-threaded apps."

AMD BUILD Approximate Price $4,813

Case		Phanteks Enthoo Pro 2 Tempered Glass	$289
PSU	NEW	**EVGA SuperNOVA 1000 P5 1000W - 80+ Platinum**	**$239**
Mobo		MSI MAG X670E Tomahawk Wi-Fi AM5	$458
CPU	NEW	**AMD Ryzen 9 9950X**	**$1,029**
Cooler		Nzxt Kraken 360 360mm AIO	$249
GPU		Powercolor Radeon RX 7900 XTX Hellhound OC 24GB	$1,599
RAM		64GB (2x32GB) Teamgroup T-Create Expert @ 6000 C34	$319
SSD		2TB Crucial T700 PCIe 5.0 M.2	$389
SSD		2TB Lexar NM790 PCIe 4.0 M.2	$182
OS	NEW	**Windows 11 Home 64-bit OEM**	**$60**

Intel BUILD Approximate Price $4,784

Case		Phanteks Enthoo Pro 2 Tempered Glass	$289
PSU	NEW	**EVGA SuperNOVA 1000 P5 1000W - 80+ Platinum**	**$239**
Mobo	NEW	**MSI MPG Z790 Edge WiFi ATX**	**$599**
CPU		Intel Core i9-14900KF	$689
Cooler		Asus ROG Strix LC III ARGB 360mm AIO	$319
GPU	NEW	**MSI Ventus 3X OC RTX 4080 Super 16GB**	**$1,699**
RAM		64GB (2x32GB) Teamgroup T-Create Expert @ 6000 C34	$319
SSD		2TB Crucial T700 PCIe 5.0 M.2	$389
SSD		2TB Lexar NM790 PCIe 4.0 M.2	$182
OS	NEW	**Windows 11 Home 64-bit OEM**	**$60**

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FUTURE

The problem solvers

The *APC* team field problems across the spectrum of devices and software. Learn a new trick or fix you can use.

Q-See CCTV replacement

I have a self-installed security system by Q-See from 2012 – eight QCN8093B cameras with motion detection, night vision, playback, and so on. Q-See went under during Covid, and although my system works, I would like to plan for when the computer system that came with it dies. The cameras are POE, and the computer is a proprietary system with 8TB of Western Digital HD storage.

I could build a new system, but I don't know where to start. I haven't found software that seems to be able to collect data from multiple security cameras to do what this system does. Any ideas? I am not afraid to build a new computer if that's what it takes, I just don't know where to go for software.
Dorothy Meister

APC Responds: The Q-See brand was resurrected in 2022 as Qsee, but the new company has made it clear that it won't support legacy products, which is why Dorothy has this issue. Her decision to act must have been caused by a premonition, because between contacting us and responding to her queries, one of the drives had died.

The system runs two hard drives, so while she waits for a replacement, she is at least able to continue using it. APC's hunch is that the system will work for many years yet – way beyond the life of the drives – but it's still an idea to plan ahead.

Many Q-See models were based on OEM Dahua kit, which bodes well for cannibalising them in a different system as they're likely to support the ONVIF protocol; however, they're likely to need a fair bit of setting up – including a full hardware reset. One excellent online resource is IPcamtalk. In particular, follow the thread at **https://ipcamtalk.com/threads/q-see-cam-issue.62551**, which covers the specifics of Dorothy's exact model.

IPcamtalk is home to Blue Iris, which gives you NVR functionality from your main PC. This would require Dorothy to connect the cameras directly to her network via intermediary hardware, such as a PoE switch, and would mean leaving her PC switched on 24-7. Another option is to explore NAS-based systems, but as both Synology and QNAS charge for their surveillance packages, you might want to investigate this tutorial on motionEye (see **https://github.com/motioneye-project/motioneye**), which pairs with a self-built NAS server build. It's not that polished, but does offer core features like motion detection triggers and setting zones for each camera.

Alternatively, Dorothy could source a replacement NVR device – the forum recommends EmpireTech (**https://empiretech01.com/**) as a potential alternative that could work with legacy Q-See cameras, but we'd recommend getting in touch directly to enquire about their suitability for her specific models before investing in one.

Qsee
4K Ultra HD

Old cameras can be reused if they're ONVIF-compatible.

Switching audio interfaces

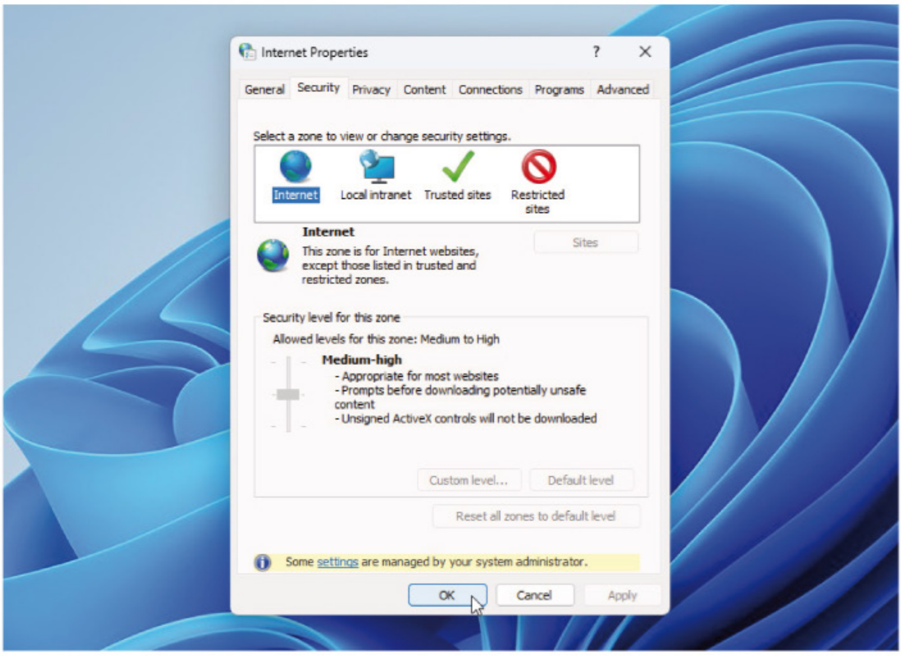
I'm using a Windows 11 Pro laptop, and would like to know how to hook up two audio interfaces on the same laptop. I use Cakewalk as my DAW, and I hooked up a Focusrite audio interface to record MIDI sounds from my electronic keyboard. I also use the VEGAS Pro video editor, and would like to hook up an external Sound Blaster soundcard to allow me to edit videos with 5.1 surround sound. I need these audio interfaces to work independently, so when using VEGAS, I only need to use the Sound Blaster card, switching to the Focusrite card for recording MIDI. I've been told a mixer can do the trick. Can you help and perhaps suggest a mixer for such a task?
George Criezis

APC Responds: We're going to assume you need a separate Sound Blaster soundcard, because your Focusrite model doesn't support 5.1 and 7.1 surround sound, as some higher-end models do. If it did, it would render a second audio interface redundant.

The good news is that you shouldn't need any mixer software. Both Focusrite and Sound Blaster cards should coexist alongside your laptop's default audio device, and you shouldn't need to manually switch between them, because both Cakewalk and VEGAS Pro allow you to choose a default audio interface.

If you were to set either device as your default audio device in Windows via Settings > System > Sound, then that device should be the default in programs where you've not specified which audio device to use. You'd need to configure the other program to use the non-default device.

In Cakewalk, this involves going to Edit > Preferences. Navigate to Audio > Devices to see if the Focusrite is present



Select a zone to view or change security settings.

Internet

This zone is for Internet websites, except those listed in trusted and restricted zones.

Security level for this zone

Allowed levels for this zone: Medium to High

Medium-high

- Appropriate for most websites
- Prompts before downloading potentially unsafe content
- Unsigned ActiveX controls will not be downloaded

Some settings are managed by your system administrator.

Your antivirus may block access to the Security tab of Internet Properties.

– if it is, make it the default for Input and Output. If it isn't, you may need to go to Audio > Playback and Recording to set Driver Mode to ASIO or WASAPI Shared first. Once set, Cakewalk will default to Focusrite, whether it's your default audio device or not. In VEGAS Pro, navigate to Options > Preferences > Audio device tab to set up your Sound Blaster card as the default when using that program.

Weird encryption

I've recently noticed some strange behavior on my PC. Any files I download in my web browser appear on my PC with a yellow padlock over the icon, regardless of where I save them to. I only noticed this when I attempted to share some images online – they ended up appearing to be corrupt, which I traced to files displaying this yellow padlock icon. The files open fine on my PC, but what's going on?
Fred Mosby

APC Responds: It appears that Windows' default file encryption (EFS) has been enabled on your Downloads folder, Fred. It's a quirk of all Chromium-based browsers, including Chrome, Edge, and Vivaldi, that if the Downloads folder itself is set to be encrypted, then all files you download will be encrypted too, regardless of where you save them. *APC* suspects that Chromium downloads the file to Downloads – thus encrypting it – before it moves to your chosen destination. The same behavior isn't found in Firefox, where only files downloaded to Downloads are encrypted.

You can decrypt all files within the Downloads folder by right-clicking Downloads and choosing Properties. Click the Advanced button and clear 'Encrypt contents to secure data' before clicking OK twice. When prompted, allow Windows to decrypt all files and sub-folders.

However, any files you save outside the Downloads folder remain encrypted. You can manually remove the encryption by right-clicking one or more files in a folder and choosing Show More Options. You'll see a File Ownership sub-menu – expand this, and click Personal. You can apply this to a single file or all the files in a folder, but if they're scattered across multiple folders, you may need help tracking them all down.

To find out which files remain encrypted, open a Command Prompt and enter the following command:

```
cipher /u /n /h
```

This will produce a list of every encrypted file on your PC – you'll need to locate each one and decrypt it (or decrypt in bulk if more than one is encrypted). If the list is big, consider producing a text doc listing all the files:

```
cipher /u /n /h > %UserProfile%\Documents\encrypted.txt
```

From here, you can visit each folder and decrypt all the files inside. Good luck!

Network security glitch

I'm encountering several hurdles when attempting to connect to my NAS server's network share. While it appears under Network in File Explorer, double-clicking it results in being told I cannot access it. Windows' diagnostic reveals nothing. I can still connect to the drive by typing its IP address into the Address bar, but I'm told, 'You can't access this shared folder because your organisation's security policies block unauthenticated guess access'. I also get a warning about potentially harmful files when I try to copy anything to or from the drive. Can I remove these messages?
Andy Welch

APC Responds: The first problem can be resolved with a trip to Group Policy Editor (gpedit.msc) in Windows 10/11 Pro – navigate to Computer configuration > Administrative Templates > Network > Lanman Workstation and double-click 'Enable insecure guest logons', then set it to Enabled and click OK. Not only is guest browsing restored, you'll be able to access your server from its Network shortcut again (if you're a Windows 10/11 Home user, you can apply the same fix via a trip to Registry Editor. Navigate to HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\LanmanWorkstation\Parameters, double-click the AllowInsecureGuestAuth value – create it as a DWORD Value if it's not present—and change it to 1).

The second issue is a consequence of connecting to your NAS via its IP address, so it's technically solved by the fact that you can now connect via its NetBIOS name. However, the warning may remain if you log on through your server's IP address. If this is unavoidable, try removing the warning by adding your server's IP address (or your entire local network using wildcards like 192.168.0.*) to your local intranet. Visit **https://superuser.com/questions/149056** for a discussion about doing this.

If you access the dialog only to find the options are grayed out with a warning that 'Some settings are managed by your system administrator', this may indicate a third-party tool – typically your antivirus software – may be blocking access for security reasons. Check its support documents or forum for a possible workaround, but ultimately, if you can connect through its NetBIOS name, do so. ■

Boost your Wi-Fi

What do we want? Faster Wi-Fi! Nate Drake shows how it's done.

YOU'LL NEED
- USB Wi-Fi antenna (optional)
- Router with open source firmware (optional)

When wireless networks were introduced in the 1990s, they were widely derided as being clunky, slow, and prone to interference. The first widely adopted wireless networking standard (802.11b) offered speeds of just 11 Mbps. In other words, it would have taken at least 12 minutes to copy a 1GB file from one network device to another.

The introduction of subsequent Wi-Fi standards like 802.11n and 802.11ac welcomed new wireless bands, channels, and other features for optimising wireless performance. That said, Wi-Fi can still be prone to slow speeds, dropped connections, and wireless interference.

This is particularly true if you live in an area with multiple access points and devices that can crowd out existing radio frequencies very quickly. This tutorial focuses on some basic steps you can take to improve the Wi-Fi signal in your home. This includes selecting and positioning the right router, as well as tweaking your Wi-Fi channels for optimum performance.

Eliminate interference

Fundamentally, Wi-Fi is a line-of-sight radio technology. In other words, it doesn't work by surrounding your device with a wireless signal, but by forming a direct connection.

There are simple steps you can take to facilitate this if you're finding that your wireless signal is weak and/or intermittent. Typically, placing your router in a central location will provide the best Wi-Fi signal across your home.

If there are multiple floors in your building, but the router's on the ground floor, place it on a high access point like a shelf to strengthen the signal. Walls, floors, and metal objects are all potential sources of interference. Even repositioning your router by a few centimetres can make a huge difference.

If your router does have an antenna, it's most likely omnidirectional. In other words, it's designed to provide Wi-Fi coverage in as close an approximation to a perfect sphere as possible. This Decibel-isotropic (dBi) value is calculated by combining the number of decibels with the Antenna 'gain'.

Generally, the higher the gain, the more directional an antenna. This means that theoretically, you could replace the omni-directional antennas on your router with 'high-gain' ones.

This can improve Wi-Fi signal strength for specific devices. A good analogy for this is to imagine narrowing the beam on a flashlight to see an object more clearly. This can be useful if you have a device in a fixed location like a Wi-Fi repeater. However, if you want a reliable Wi-Fi network, it's likely that you'll need to be able to connect from multiple locations.

Instead of using high-gain antennas, consider buying a router with multiple omni-directional ones instead like the Asus ROG Rapture GT-AX11000. **[Image A]**

A

Using a more modern router also ensures that you'll be using Wi-Fi 6 or greater. This includes optimisation features like MU-MIMO (Multi-User, Multiple-Input, Multiple-Output), which can handle up to eight simultaneous data streams.

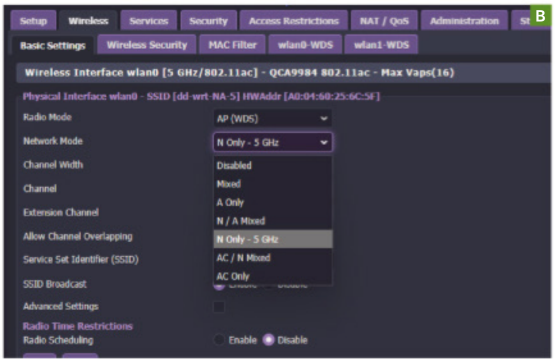
It also supports OFDMA (Orthogonal Frequency Division Multiple Access), allowing WI-Fi channels to be broken down into smaller sub-channels. This allows multiple devices to transmit simultaneously with less interference compared to previous wireless standards.

Check your channels

The most common wireless tech, 802.11g (wireless-G), operates at 2.4GHz. This means that simply switching your wireless network to use the 5GHz or 6GHz band can eliminate most sources of interference and offer faster speeds. **[Image B]** However, it can also reduce your wireless range.

Whichever band or bands you deploy, you can also improve Wi-Fi performance by avoiding channels that are too congested. By default, your router automatically selects these, but doesn't always switch to channels with more capacity when the original channel becomes crowded.

The specific steps for manually configuring your channel will vary depending on your firmware. For instance, if you're using a DD-WRT router (which we strongly recommend), there's a dedicated channel



B

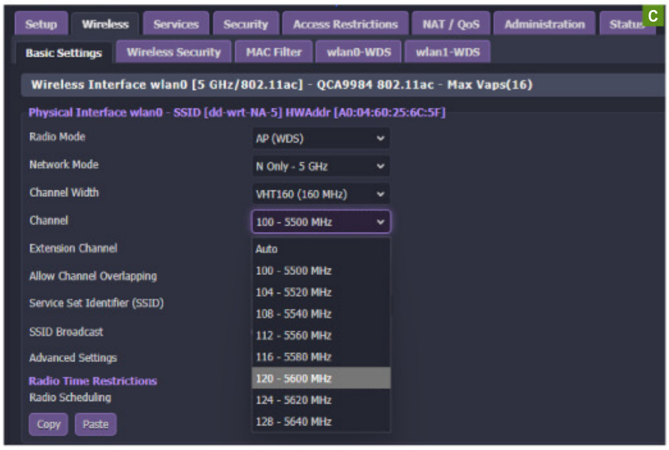
Wireless Interface wlan0 [5 GHz/802.11ac] - QCA9984 802.11ac - Max Vaps(16)

Physical Interface wlan0 - SSID [dd-wrt-NA-5] HWAddr [A0:04:60:25:6C:5F]

Radio Mode: AP (WDS)

Network Mode: N Only - 5 GHz

Radio Scheduling: ○ Enable ● Disable



Wireless Interface wlan0 [5 GHz/802.11ac] - QCA9984 802.11ac - Max Vaps(16)

Physical Interface wlan0 - SSID [dd-wrt-NA-5] HWAddr [A0:04:60:25:6C:5F]

Radio Mode: AP (WDS)
Network Mode: N Only - 5 GHz
Channel Width: VHT160 (160 MHz)
Channel: 100 - 5500 MHz
Extension Channel
Allow Channel Overlapping
Service Set Identifier (SSID)
SSID Broadcast
Advanced Settings
Radio Time Restrictions
Radio Scheduling

drop-down menu under 'Wireless' > 'Basic Settings'. **[Image C]**

Naturally, it helps to know which channels are the least used in your area. One of the best tools for this is WinFi. You can download the installer from https://github.com/HelgeKeck/winfi/releases). When WinFi launches, it will display all the wireless networks in your area, along with the channels they use (in the 'CH' column). **[Image D]**

On the 2.4GHz band, Wi-Fi operates on channels 1 to 14. Note down the least frequently used of these. Typically, channels 1, 11, and 6 receive the least interference. The channels supported on each band can vary based on where your router was manufactured. For example, European routers often support channels 12 and 13. Check the 'CC' column in WinFi to discover the country code for which your Access Point has been configured.

Wi-Fi networks on the 5GHz band operate on channels 36 to 165. In the case of this band, try to find a channel that's as far away from the others as possible.

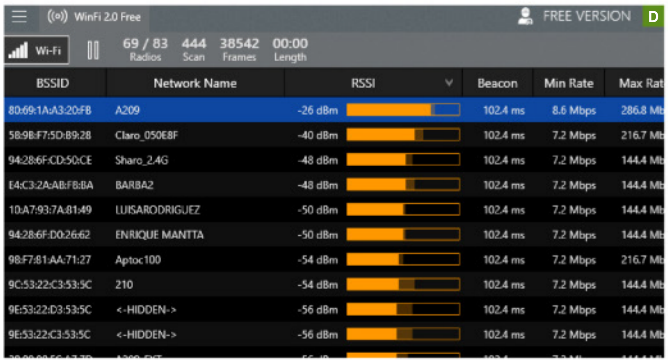
The 6GHz band has 59 available channels, and supports 'Preferred Scanning Channels' (PSC) to manage channel discovery. If you're using this band, you're unlikely to experience channel congestion.

If you have any Wi-Fi range extenders or other APs, make sure that these use a different channel to your main router. This may sound counter-intuitive, but even a single Wi-Fi router with multiple radio signals can conflict with itself if they're all using the same channel.

Change your channel width

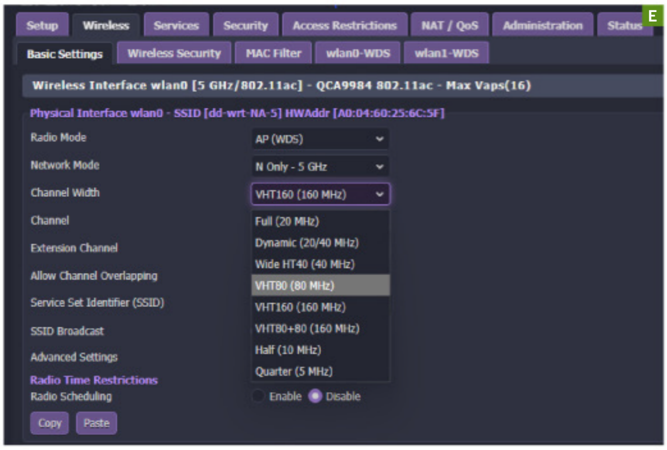
Each Wi-Fi channel is allotted a certain 'width'. For instance, the traditional 802.11 standard allotted 20MHz to each channel in the 2.4GHz band. The subsequent 802.11n standard introduced the concept of 'channel bonding', ie. combining 2 x 20MHz channels into a single 40MHz one.

Generally speaking, the wider a channel, the greater the potential network speed. In the case of 802.11, this effectively doubled the throughput of each channel. The 802.11ac standard has even more bonding options to create 80MHz and 160MHz channels. However, increasing channel width can actually decrease network speed. This is because bonding multiple overlapping channels can cause interference. For instance, in the 2.4GHz band, eight out of the 11 channels overlap.



69 / 83 Radios
444 Scan
38542 Frames
00:00 Length

BSSID	Network Name	RSSI	Beacon	Min Rate	Max Rat
80:69:1A:A3:20:FB	A209	-26 dBm	102.4 ms	8.6 Mbps	286.8 Mb
58:9B:F7:5D:B9:28	Claro_050E8F	-40 dBm	102.4 ms	7.2 Mbps	216.7 Mb
94:28:6F:CD:50:CE	Sharo_2.4G	-48 dBm	102.4 ms	7.2 Mbps	144.4 Mb
E4:C3:2A:AB:FB:BA	BARBA2	-48 dBm	102.4 ms	7.2 Mbps	144.4 Mb
10:A7:93:7A:81:49	LUISARODRIGUEZ	-50 dBm	102.4 ms	7.2 Mbps	144.4 Mb
94:28:6F:D0:26:62	ENRIQUE MANTTA	-50 dBm	102.4 ms	7.2 Mbps	144.4 Mb
98:F7:81:AA:71:27	Aptoc100	-54 dBm	102.4 ms	7.2 Mbps	216.7 Mb
9C:53:22:C3:53:5C	210	-54 dBm	102.4 ms	7.2 Mbps	144.4 Mb
9E:53:22:D3:53:5C	<-HIDDEN->	-56 dBm	102.4 ms	7.2 Mbps	144.4 Mb
9E:53:22:C3:53:5C	<-HIDDEN->	-56 dBm	102.4 ms	7.2 Mbps	144.4 Mb



Wireless Interface wlan0 [5 GHz/802.11ac] - QCA9984 802.11ac - Max Vaps(16)

Physical Interface wlan0 - SSID [dd-wrt-NA-5] HWAddr [A0:04:60:25:6C:5F]

Radio Mode: AP (WDS)
Network Mode: N Only - 5 GHz
Channel Width: VHT160 (160 MHz)
Channel
Extension Channel
Allow Channel Overlapping
Service Set Identifier (SSID)
SSID Broadcast
Advanced Settings
Radio Time Restrictions
Radio Scheduling: ○ Enable ● Disable

This means you have to approach tweaking your channel widths with caution. Firstly, make sure that the feature is supported by your router. For example, if you're using DD-WRT there's a dedicated 'Channel Width' drop-down menu under 'Wireless'>'Basic Settings'.

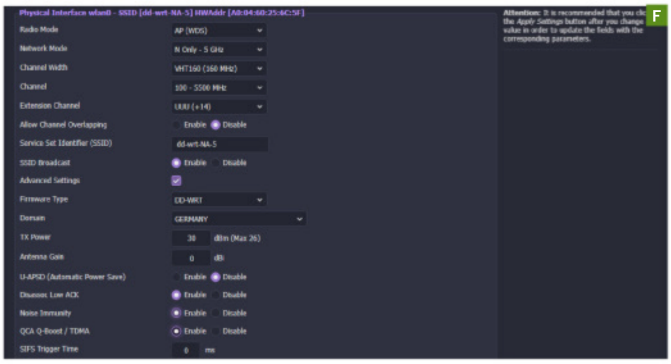
If you're using the 2.4GHz band, it's best to set the channel width to 20MHz to avoid overlapping. However, the 5GHz band is more flexible. This is because 24 out of its 45 channels don't overlap. In this case, try changing the channel width to 40MHz or 80MHz to see if the signal improves. **[Image E]**

Remember that not all Wi-Fi devices may support your chosen channel width. If they're not connecting, check if your router supports enabling multiple channel widths simultaneously.

If you find that devices keep losing their connection, you can also experiment with narrowing the channel width. Although this can impact the theoretical data throughput between data and devices, in practice, the channel is less likely to be subject to interference.

Your router may also support more advanced features, like Time Division Multiple Access (TDMA). This assigns time slots to devices so that each can use channels in rapid succession without interference from each other. Select router firmware like DD-WRT also supports 'noise immunity', which instructs your router to ignore certain irrelevant signals by tuning driver parameters. **[Image F]**

Ultimately, it takes time to determine which exact settings will perform well with your chosen wireless network. Keep experimenting to find the best configuration for your devices. ■



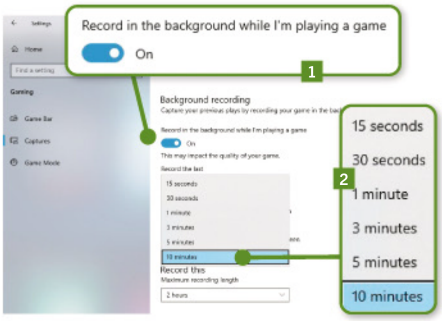
Physical Interface wlan0 - SSID [dd-wrt-NA-5] HWAddr [A0:04:60:25:6C:5F]

Radio Mode: AP (WDS)
Network Mode: N Only - 5 GHz
Channel Width: VHT160 (160 MHz)
Channel: 100 - 5500 MHz
Extension Channel: UUU (+14)
Allow Channel Overlapping: ○ Enable ● Disable
Service Set Identifier (SSID): dd-wrt-NA-5
SSID Broadcast: ● Enable ○ Disable
Advanced Settings: ☑
Firmware Type: DD-WRT
Domain: GERMANY
TX Power: 30 dBm (Max 26)
Antenna Gain: 0 dBi
U-APSD (Automatic Power Save): ○ Enable ● Disable
Disassoc Low ACK: ● Enable ○ Disable
Noise Immunity: ● Enable ○ Disable
QCA Q-Boost / TDMA: ● Enable ○ Disable
SIFS Trigger Time: 0 ms

Attention: It is recommended that you cli the Apply Settings button after you change value in order to update the fields with the corresponding parameters.

Make Windows better

Expert tips for a better experience.


Settings
Home
Find a setting
Gaming
Game Bar
Captures
Game Mode
Record in the background while I'm playing a game
On
1
Background recording
Capture your previous plays by recording your game in the bac
Record in the background while I'm playing a game
On
This may impact the quality of your game.
Record the last
15 seconds
30 seconds
1 minute
3 minutes
5 minutes
10 minutes
Record this
Maximum recording length
2 hours
2
15 seconds
30 seconds
1 minute
3 minutes
5 minutes
10 minutes

WINDOWS 10 & 11

Record the previous 30 seconds in games

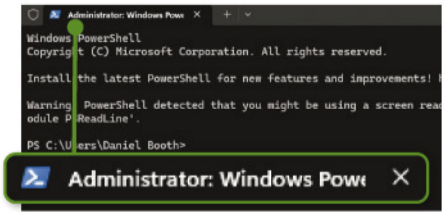
Game Bar in Windows lets you record videos of games as you play them (though you can use it to record anything you do on your computer). One of its smartest features is to record the previous moments of a game. You can activate this when you've done something memorable and want to capture it as a video.

First, press Windows key+I to open Settings, then click Gaming. Turn on the Game Bar slider at the top of the page. Next, click Captures on the left (or in the centre in Windows 11), then turn on 'Record in the background while I'm playing a game' (1 in our screenshot below). Now set how long you want to record for (from 15 seconds to 10 minutes) 2. This means Game Bar is always recording in the background, but you'll only save the amount of time you set when you press the Windows+Alt+G keyboard shortcut. The clip will be saved in your Videos, Captures folder.

WINDOWS 10 & 11

Launch tools in admin mode using keyboard shortcut

Some Windows tools (like Command Prompt/PowerShell) and third- party programs (including several from NirSoft – see above right) offer more features when you use them in admin mode. You can usually open these by right- clicking their taskbar icon and selecting 'Run as administrator', but you can also do this by keeping the keyboard shortcut Ctrl+Shift pressed then clicking the icon. If you open Command Prompt/ PowerShell in admin mode, you'll see it confirmed at the top left (pictured below left).


Administrator: Windows Powe
Administrator: Windows Powe

```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements!

Warning: PowerShell detected that you might be using a screen rea
odule PSReadLine'.

PS C:\Users\Daniel Booth>
```

Windows 10 & 11

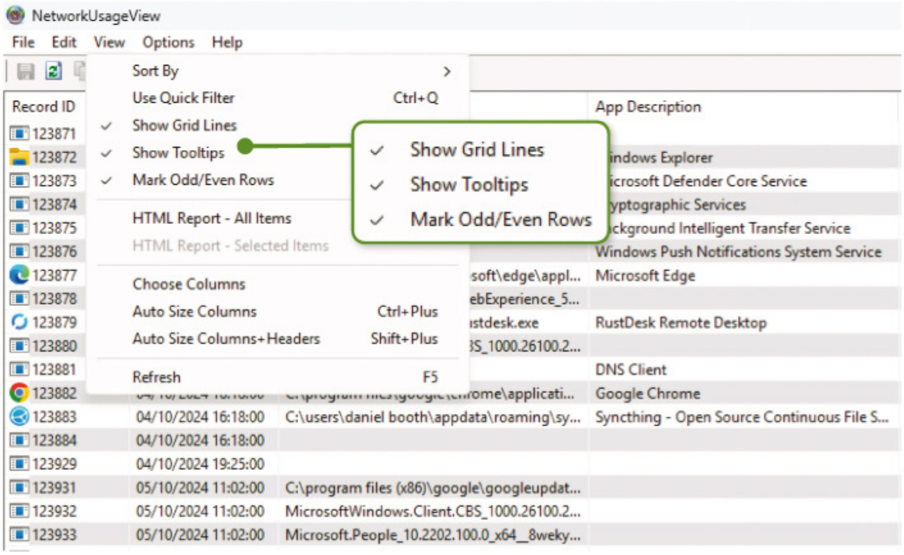
See how much data your programs are using in NetworkUsageView

NirSoft, one of our favourite software developers, has updated NetworkUsageView to fix a bug that was causing it to crash on computers running the Windows 11 24H2 update.

This program shows how much data your programs have used, letting you identify those that hog a lot of your resources – look in the Bytes Sent and Received columns on the right. You can see this information in Windows Settings and Task Manager, but NetworkUsageView has a better design.

Visit **tinyurl.com/APC543nuv** then scroll down to the bottom and click either the 32bit or 64bit download link (under the Feedback heading) depending on which type of processor your computer has. Extract the ZIP file then launch the program.

Like most NirSoft tools, you can make the information easier to see by clicking View then ticking Show Grid Lines and Mark Odd/Even Rows (see screenshot). This option is also available in NirSoft's WebBrowserPassView.


NetworkUsageView
File
Edit
View
Options
Help
Sort By
Use Quick Filter Ctrl+Q
✓ Show Grid Lines
✓ Show Tooltips
✓ Mark Odd/Even Rows
HTML Report - All Items
HTML Report - Selected Items
Choose Columns
Auto Size Columns Ctrl+Plus
Auto Size Columns+Headers Shift+Plus
Refresh F5
✓ Show Grid Lines
✓ Show Tooltips
✓ Mark Odd/Even Rows

Record ID			App Description
123871			
123872			indows Explorer
123873			icrosoft Defender Core Service
123874			yptographic Services
123875			ckground Intelligent Transfer Service
123876			Windows Push Notifications System Service
123877		soft\edge\appl...	Microsoft Edge
123878		ebExperience_5...	
123879		istdesk.exe	RustDesk Remote Desktop
123880		3S_1000.26100.2...	
123881			DNS Client
123882		ome\applicati...	Google Chrome
123883	04/10/2024 16:18:00	C:\users\daniel booth\appdata\roaming\sy...	Syncthing - Open Source Continuous File S...
123884	04/10/2024 16:18:00		
123929	04/10/2024 19:25:00		
123931	05/10/2024 11:02:00	C:\program files (x86)\google\googleupdat...	
123932	05/10/2024 11:02:00	MicrosoftWindows.Client.CBS_1000.26100.2...	
123933	05/10/2024 11:02:00	Microsoft.People_10.2202.100.0_x64__8weky...	

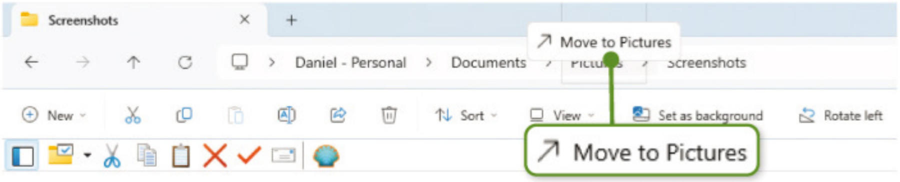
WINDOWS 11

Drag files on to File Explorer's 'breadcrumbs' bar

The 24H2 update to Windows 11, released in the autumn, brings back the option to move files by dragging and dropping them on to the address bar in File Explorer. Microsoft removed this back in 2021, much to the annoyance of users. To do it, just click on a file and while holding this down move the file to the bar. Release it when you see the 'Move to...' prompt appear.

In our example, we've moved a file to the Pictures folder (see screenshot below), though we could instead have placed it in Documents or Screenshots.

Incidentally, the File Explorer bar uses a 'breadcrumbs' design – named after Hansel and Gretel's trick to leave a path returning home. It shows the 'trail' of one folder inside another. ■


Screenshots
Move to Pictures
Daniel - Personal
Documents
Pictures
Screenshots
New
Sort
View
Set as background
Rotate left
Move to Pictures

Make Office better

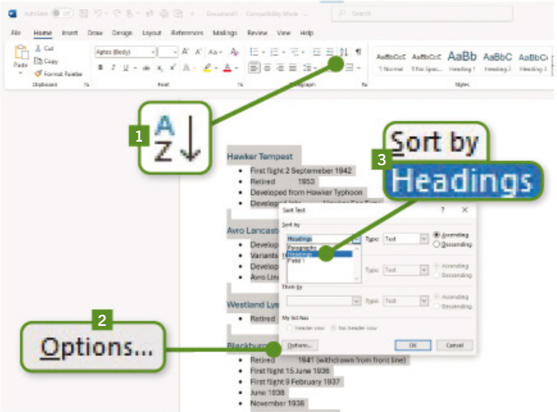
Expert tips for a better experience.

ONLYOFFICE

Add text from files saved on your PC

OnlyOffice 8.2, released last October, adds the option to import text from a file on your computer, saving you the hassle of opening the document then cutting and pasting the text. The option appears only in the Document and PDF Form tools (not Presentation or Spreadsheet), so open either then click Insert at the top, followed by 'Text from File' (1 in our screenshot below right). Now click 'Text from the local file' 2 then find and click the relevant file on your computer. The text will appear in your document.

There's also a 'Text from the URL file' option 3 that lets you insert text from a file you've saved online. Click it to see a box where you can type the file's URL.


1
2
Options...
3
Sort by
Headings

MICROSOFT WORD

Alphabetise headings but not bullet points

The Sort tool in Word lets you list headings alphabetically without changing the order of the bullet-point lists below them. In our example, we want to alphabetise our headings – planes from World War 2 – but keep the bullet points as they are.

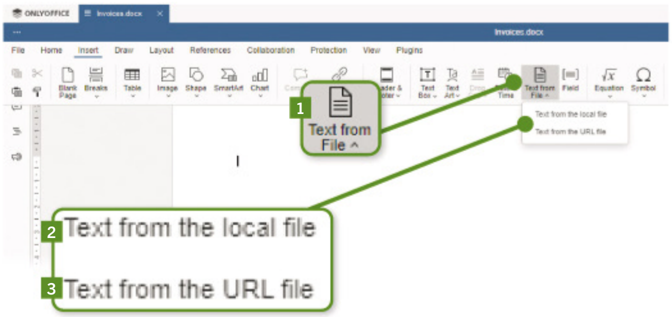
First, press Ctrl+A to select all the text then click the Home tab. Next, click the A-Z 'Sort' icon (1 in our screenshot left) to open the Sort Text box, then the Options button 2. Select Other under 'Separate fields at' then OK. Finally, select Headings in the 'Sort by' dropdown menu 3 then click OK.

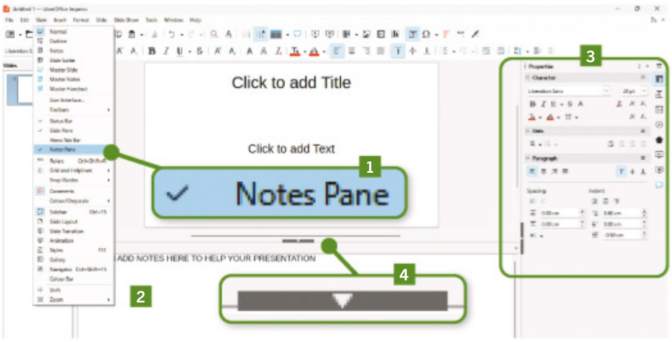
LIBREOFFICE IMPRESS

Add notes pane to presentation slides

The most recent version of LibreOffice (24.8), released last August, added a Notes panel to the presentation tool Impress. This appears below your slides, letting you add notes to help with presentations.

To turn this on, click View at the top then select Notes Pane (1 in our screenshot below). You'll see the Notes pane where you can type 2, with formatting tools on the right 3. Click the arrow to close the pane 4, then click it again to open it whenever you need to make more notes. ■


1
Text from File
2
Text from the local file
3
Text from the URL file


Click to add Title
Click to add Text
1
Notes Pane
ADD NOTES HERE TO HELP YOUR PRESENTATION
2
3
4

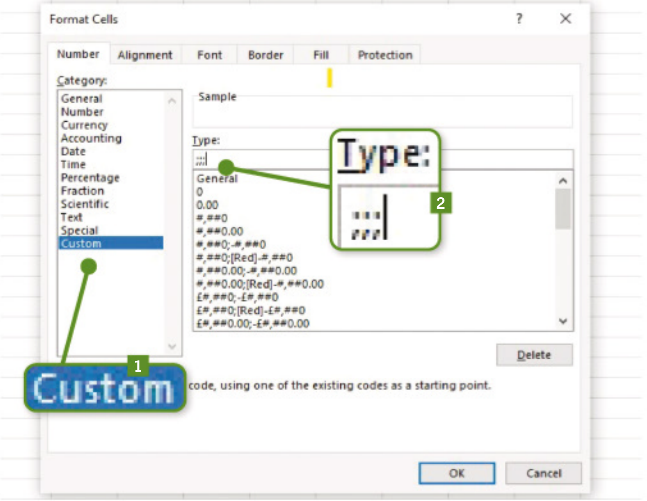
Libreoffice Calc & Microsoft Excel

Hide cells when printing spreadsheets

When printing your spreadsheets you can hide the data in particular cells, which is useful if they contain sensitive information such as financial or personal details. To do this, select the cells then click Home at the top followed by the small 'Number Format' diagonal arrow at the bottom right of the Number section.

Now click Custom in the Category box on the left (1 in our screenshot) and type three semi-colons (;;;) in the Type field on the right 2. Click OK to confirm. This will make the data disappear on screen, and it won't appear when you print. To see what the cell contains, just click it and look in the Formula bar at the top.

To do this in LibreOffice Calc, select the cell then right-click it and choose Format Cells. Now click the Numbers tab then select 'User-defined' in the Category list. Type ;;; in the Format Code box at the bottom then click OK.


Format Cells
?
×
Number
Alignment
Font
Border
Fill
Protection
Category:
General
Number
Currency
Accounting
Date
Time
Percentage
Fraction
Scientific
Text
Special
Custom
Sample
Type:
;;;
General
0
0.00
#,##0
#,##0.00
#,##0;-#,##0
#,##0;[Red]-#,##0
#,##0.00;-#,##0.00
#,##0.00;[Red]-#,##0.00
£#,##0;-£#,##0
£#,##0;[Red]-£#,##0
£#,##0.00;-£#,##0.00
Delete
code, using one of the existing codes as a starting point.
OK
Cancel
1
Custom
2
Type:
;;;

Browser tips

Secret settings and best extensions

CHROME

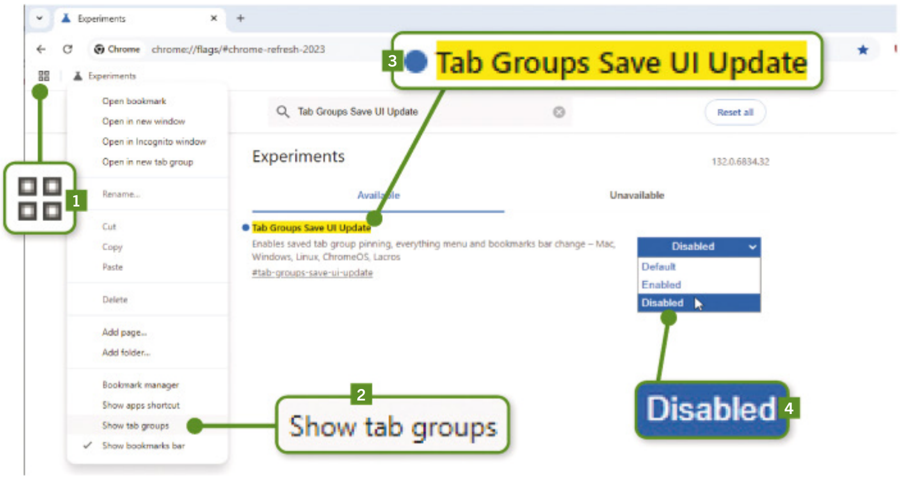
Remove the new ‘Tab groups’ button

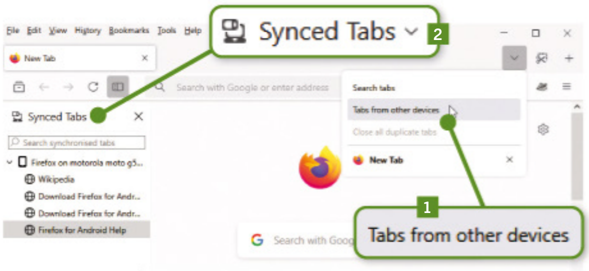
Google made lots of tweaks to Chrome in 2024, some of which were more useful than others. One of the most noticeable was the addition of a ‘Tab groups’ button to the browser’s Bookmarks bar. This looks like a grid of four squares and appears to the left of your bookmarks (1 in screenshot below).

While this button will come in handy if you use Chrome’s ‘Tab groups’ feature to organise your tabs into themed groups, it’s otherwise likely to prove annoying.

Thankfully, you can remove the ‘Tab groups’ button if you don’t need it. Rather than right-click the button and choose Hide or Delete (which would be the obvious solution), you have to right-click elsewhere on the Bookmarks bar and deselect the ‘Show tab groups’ option 2. The button will then disappear.

To disable the ‘Tab groups’ button permanently, type **chrome://flags** into Chrome’s address bar and press Enter to load the Experiments page. Now find the entry Tab Groups Save UI Update 3, and then choose Disabled in its dropdown menu 4 and relaunch Chrome for the settings to take effect.


Experiments
chrome://flags/#chrome-refresh-2023
1
Open bookmark
Open in new window
Open in Incognito window
Open in new tab group
Rename...
Cut
Copy
Paste
Delete
Add page...
Add folder...
Bookmark manager
Show apps shortcut
Show tab groups
Show bookmarks bar
3 Tab Groups Save UI Update
Tab Groups Save UI Update
Reset all
Experiments
132.0.6834.32
Available
Unavailable
Tab Groups Save UI Update
Enables saved tab group pinning, everything menu and bookmarks bar change – Mac, Windows, Linux, ChromeOS, Lacros
#tab-groups-save-ui-update
Disabled
Default
Enabled
Disabled
2 Show tab groups
Disabled 4


Synced Tabs 2
Synced Tabs
Search synchronised tabs
Firefox on motorola moto g5...
Wikipedia
Download Firefox for Andr...
Download Firefox for Andr...
Firefox for Android Help
Search tabs
Tabs from other devices
Close all duplicate tabs
New Tab
1 Tabs from other devices

FIREFOX

View tabs on other devices more privately

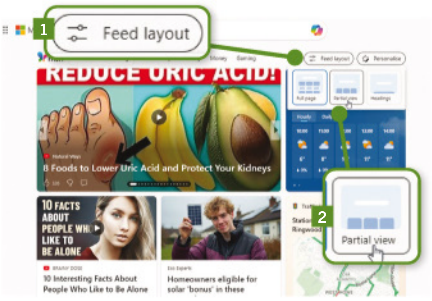
Two years ago, Mozilla added a feature called Firefox View to its browser. This lists the tabs you currently have open or have closed recently, and lets you search your browsing history. It also offers the useful option to view tabs you have open on other devices, provided you’re signed into your Mozilla account and have ‘Open tabs’ selected in Firefox’s Sync settings.

However, it’s fair to say Firefox users haven’t embraced the View feature as enthusiastically as Mozilla hoped. Some have even highlighted privacy concerns, because anyone glancing at your Firefox View dashboard can see every web page you’ve visited on your PC and phone.

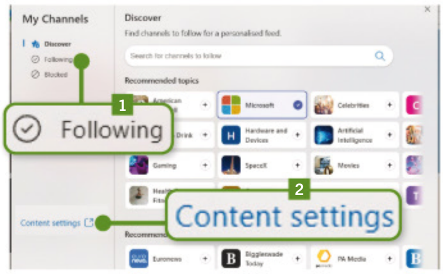
Version 133 of the browser (released at the end of November), addresses these worries by letting you view tabs on other devices without using Firefox View. This means you can remove the latter without losing access to your synced tabs.

Instead, simply click the ‘List all tabs’

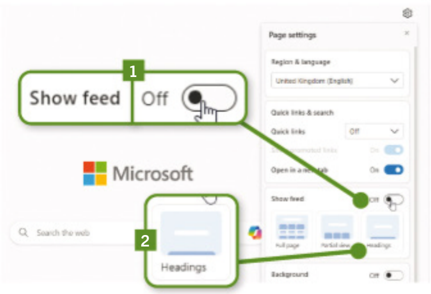
Workshop Customise your MSN feed in Edge


1 Feed layout
2 Partial view
8 Foods to Lower Uric Acid and Protect Your Kidneys
10 Interesting Facts About People Who Like to Be Alone
Homeowners eligible for solar 'bonus' in these

Click the ‘Feed layout’ button 1 in the top-right corner of your MSN feed and switch from ‘Full page’ to ‘Partial view’ 2. This pushes the feed’s content further down the New Tab page and presents it in a more condensed layout.


My Channels
Discover
Find channels to follow for a personalised feed
Recommended topics
1 Following
2 Content settings
Content settings

You can make the content of your MSN feed more relevant to your interests by clicking Personalise and ‘following’ different channels 1. Click ‘Content settings’ 2 to show or hide specific ‘cards’, including Weather, Traffic and Health.


Page settings
1 Show feed Off
Microsoft
2 Headings

To hide the MSN feed altogether, click the ‘Page settings’ cog in the top-right corner of the New Tab page and switch off ‘Show feed’ 1. Alternatively, choose ‘Headings’ 2 to show only the headlines and images from online articles.

Best extension for… Watching picture-in-picture videos

SUPER PIP

Chromium

tinyurl.com/APC543pip

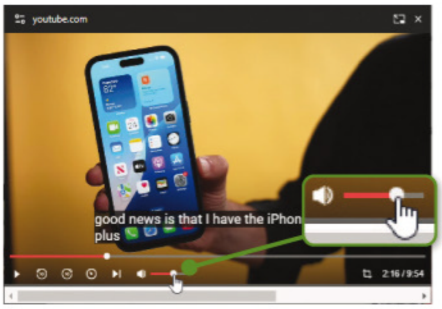
Lots of websites now support picture-in-picture (PiP) mode, allowing you to view videos in a floating player window. Though it varies between browsers, the PiP player is often quite basic, so Super PiP gives you some useful extra controls. As well as a standard Play/Pause button, you can rewind and fast-forward in 10-second increments, adjust the volume using a slider (see screenshot), control the playback speed and skip to the next video in a playlist. Best of all, the extension displays subtitles on many streaming services, provided you enable them in the main player first. To switch to and from PIP mode, simply click Super PiP's toolbar button. Press the E or S key on your keyboard to expand or shrink the player window – the extension will remember the size for next time.

If you don't like that, try…

PICTURE-IN-PICTURE FOR ALL SITES

Chromium

tinyurl.com/APC543cpip



This extension lacks Super PiP's range of controls, but works on any video site – even those that don't support PiP.

(down-arrow) button in Firefox's top-right corner and choose 'Tabs from other devices' (1 in our screenshot above). This will display a list of Synced Tabs in the browser's left-hand sidebar 2. Click the title of a tab to open the synced page in the main window.

To hide Firefox View, right-click its icon in the top-left corner of the browser and choose 'Remove from Toolbar'.

EDGE

Browse your MSN feed on New Tab pages

Microsoft has changed the name of its popular Start app to MSN – or rather it has changed it back, because the app was originally called MSN News. This also applies to the Start page – or feed – in Edge, which is now called MSN, too.

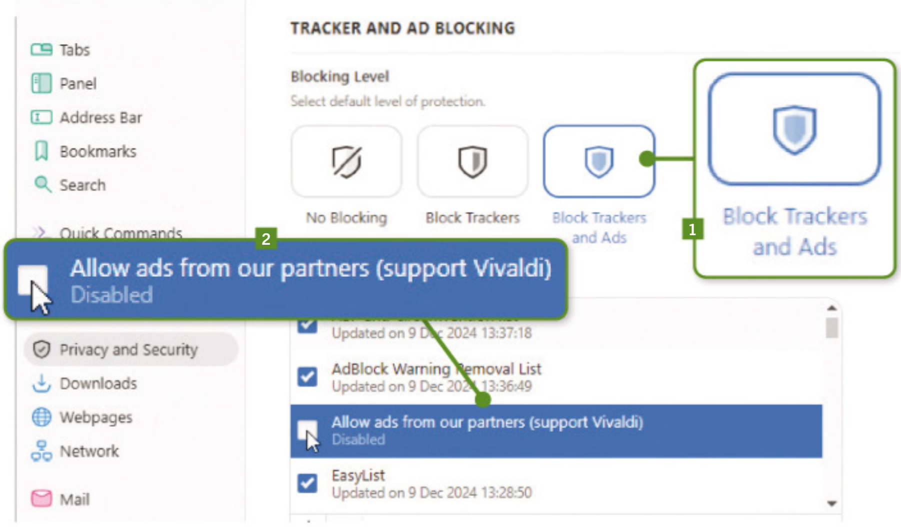
Your MSN feed displays news stories, online articles, the weather forecast, traffic updates, stock prices and more on the browser's New Tab page. Although some of its content is usually interesting, it can also feel overwhelming, so it's worth customising the feed to make it more relevant to you. See our Workshop on the opposite page to find out how.

VIVALDI

Decide whether to block all ads and trackers

Vivaldi has made some changes to its built-in tool for blocking ads and trackers. This means the browser will no longer block all such elements by default.

As Vivaldi explains in a blog post titled 'The great tracker blocker conundrum' (**tinyurl.com/APC543tracker**), the company relies heavily on revenue generated through its partnerships with search engines, so it can continue to provide its browser for free. Recently, these deals have produced "dwindling revenue", because Vivaldi's tracker blocker was preventing essential scripts from running. As a consequence, the browser will now allow some tracking scripts to run, but only those required by its search partners and only when you click something that "is obviously an ad" – or sponsored link – in their search results. Vivaldi says all other trackers will remain blocked, and those that do load will not be able to follow you to other sites.



TRACKER AND AD BLOCKING

Blocking Level

Select default level of protection.

Block Trackers and Ads

Allow ads from our partners (support Vivaldi)
Disabled

☑ Updated on 9 Dec 2024 13:37:18

☑ AdBlock Warning Removal List
Updated on 9 Dec 2024 13:36:49

☐ Allow ads from our partners (support Vivaldi)
Disabled

☑ EasyList
Updated on 9 Dec 2024 13:28:50

If that doesn't reassure you about your privacy, and you'd rather not see any ads or trackers, Vivaldi will still let you block them despite the potential loss in revenue. Click the menu button in the browser's top-left corner and choose Settings then 'Privacy and Security'.

Scroll down to the 'Tracker and Ad Blocking' section, select 'Block Trackers and Ads' (1 in our screenshot above) and click the Manage Sources button. Under 'Ad Blocking Sources', untick the option to 'Allow ads from our partners (support Vivaldi)' 2.

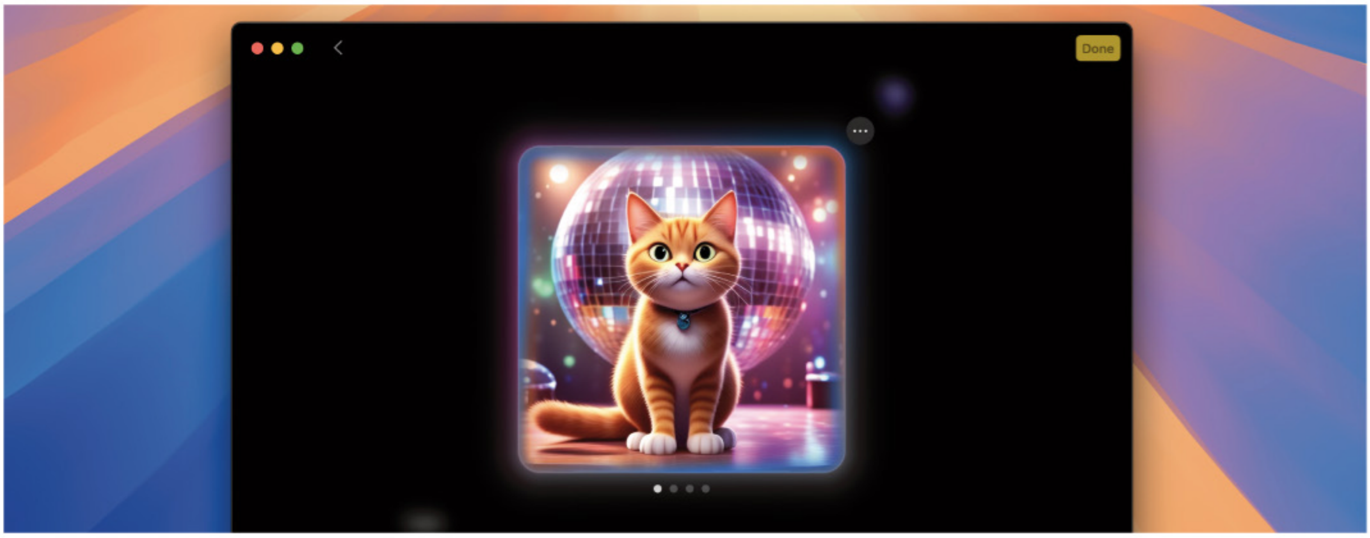
OPERA

Chat with Aria in a new tab

Opera has added another way to interact with its AI assistant, Aria. You can now move your conversation from the browser's side panel to a new tab. This gives you more space and feels more natural than typing commands into the left-hand panel.

Click the Aria button in the sidebar to launch the AI tool, then click the Conversations icon in the top-left corner. Either select a past chat or start a new one. Click the new Open button (see screenshot below) to switch from the side panel to a new tab, where you can continue your conversation.

Don't forget that you can also ask Aria questions through Opera's Command Line tool. Press Ctrl+/ to open this, then type a query or prompt. ■



Create your own AI images

Have a bit of picture-related fun with the Image Playground app.

IT WILL TAKE
5 minutes
YOU WILL LEARN
How to create original images using AI and Apple's Image Playground app
YOU'LL NEED
macOS 15.2 or later, M1 chip or later

Artificial intelligence (AI) is all the rage at the moment, and Apple is getting in on the act with Apple Intelligence. This AI is woven throughout macOS 15 (Sequoia) and helps power up Siri, rewrite text, organise your emails, and more.

A key element of Apple Intelligence is the Image Playground app, which is all about creating AI-generated images. It's very easy to use but offers a lot of power and flexibility, and whether you want to whip up a personalised image for a friend or create your own custom emoji, it's a good place to start. You can also use it to generate images in apps like Messages and Freeform. To create a custom emoji, known as Genmoji, for example, open Messages, click '+' and choose Image Playground, then enter a prompt.

Image Playground can produce mistakes and oddities, just like any other AI tool. The more descriptive your prompt is, the more likely you are to get a result you are happy with. Here, we'll show you how to use Image Playground to its full potential.

Alex Blake ■

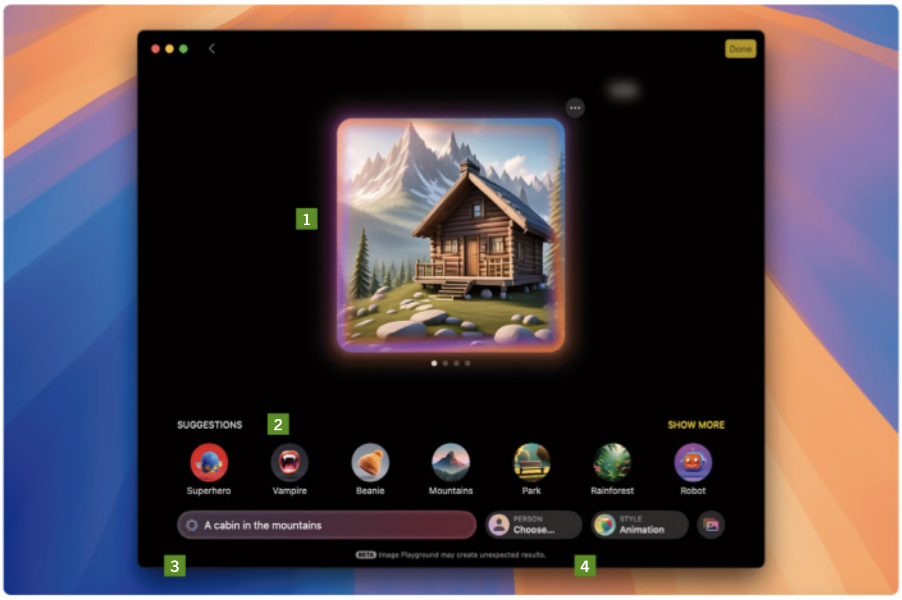
Explained… The Image Playground interface

1
Generated picture
Your created image appears here and updates whenever you add details. Scroll to generate more images.

3
Describe an image
The more descriptive your prompt is, the better. Include plenty of detail to avoid having to try again.

2
Suggestions
Click a suggestion to add it to your image's prompts or click the '–' button next to a prompt to remove it.

4
More options
Here, you can add a generic person image or a photo as a prompt or change between Animation and Illustration.



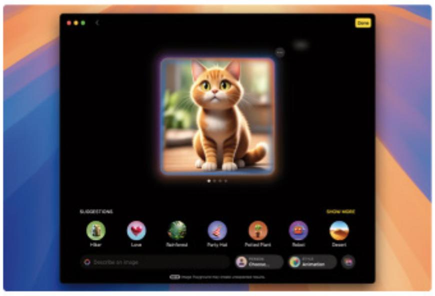
A cabin in the mountains

PERSON Choose...

STYLE Animation

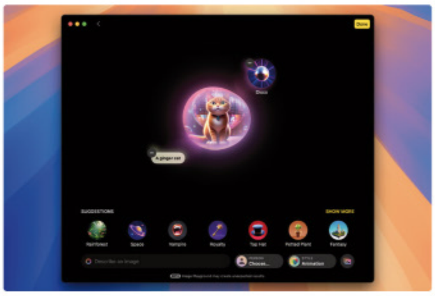
BETA Image Playground may create unexpected results.

How to Use Image Playground on your Mac



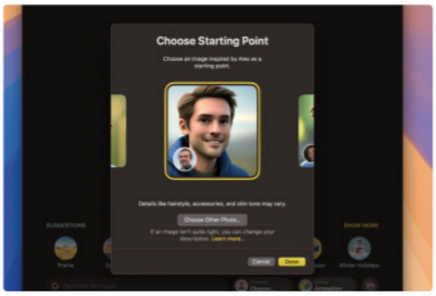
1 Describe an image

In Image Playground, type a prompt into the ‘Describe an image’ text box, then press Return. Image Playground will get to work and generate several images. Scroll to the end and more will be created automatically.



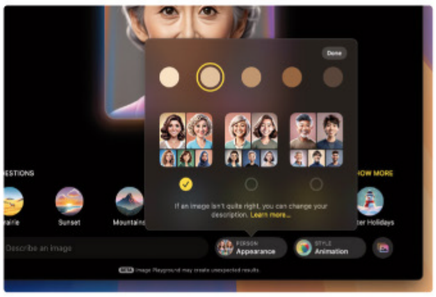
2 Suggested prompts

Click one of Apple’s suggestions to add it to your image or press the Space bar and click the ‘—’ button to remove a descriptive tag. Keep adding prompts and your image will update. Click Show More to see extra suggestions.


Choose Starting Point

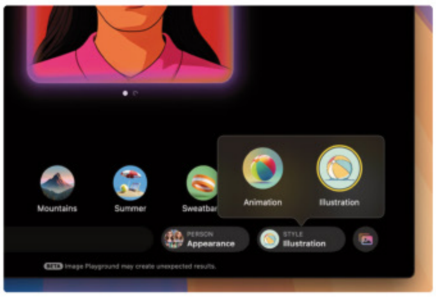
3 Starting points

You can base your image on people you know or photos you’ve taken. By the text box, select either Choose Person or the photo icon. Now pick a tagged person or an image from your library to use as the image’s base.



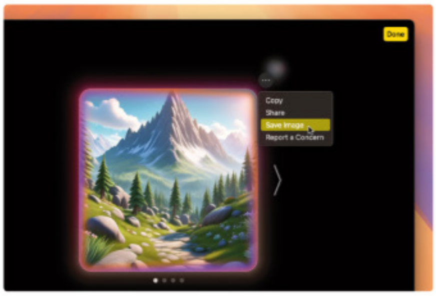
4 Create a person

The app also lets you add a person that’s not based on a photo. Click Person > Appearance, pick a skin tone, select an image style, then click Done. Image Playground will add a person’s image based on your selections.


Mountains
Summer
Sweatbar
Animation
Illustration
PERSON Appearance
STYLE Illustration

5 Image style

You can tweak your image results by selecting the Style button, which lets you choose between Animation and Illustration. Pick one and Image Playground will create new images based on the chosen image style.


Done
Copy
Share
Save Image
Report a Concern

6 Save to library

When you’re happy with a generated image, click ‘…’ to copy, share, or save it, or report a concern. You can also click Done in the top-right corner to save it to your library. The image will glow to show that it’s been saved.

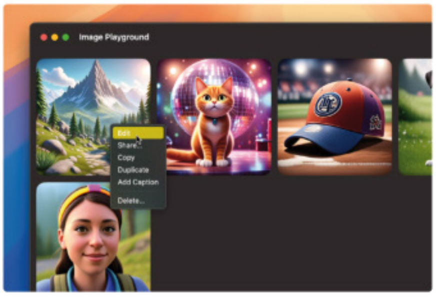
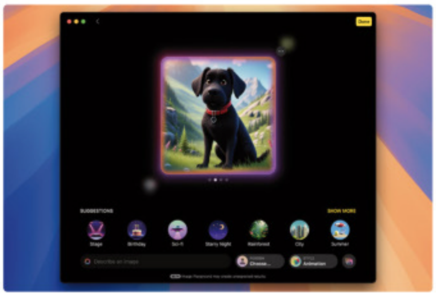


Image Playground
Edit
Share
Copy
Duplicate
Add Caption
Delete...

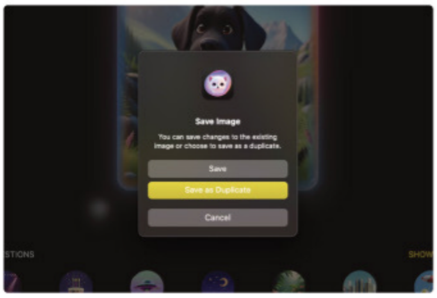
7 Edit image

Click ‘<’ in the Image Playground app’s top-left corner to view your saved image gallery. You can Ctrl-click an image and choose Edit to adjust it. You’ll now see the same options you see when creating a new image.



8 Editing options

Try adding a new element by clicking the photo icon, then Choose Photo. Alternatively, you can change the image’s style, add a new suggested element, insert or change a person, or add new details in the description box.


Save Image
Save
Save as Duplicate
Cancel

9 Copy, save or delete

Click Done and you’ll be asked if you want to overwrite the original or save a duplicate copy. You can Ctrl-click the image to copy it, duplicate it or add a caption. You can also delete what you’ve done by clicking the Trash icon.

Hide vital information

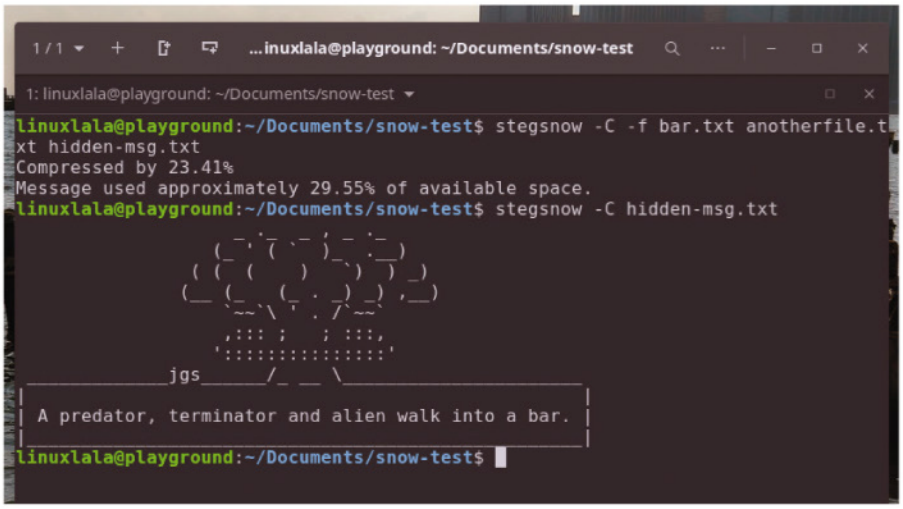
Shashank Sharma is a man of many hidden talents. Too bad he's forgotten the passphrase to unlock them all.

There's something infinitely intriguing about hiding messages in plain sight. The idea has spawned an entire field called steganography, hiding messages or information in another object. In modern day computing, steganography often involves hiding a message or an image inside another image or audio/video file. However, it's also possible to hide message in ASCII text files.

Released under the Apache 2.0 Licence, Stegsnow uses whitespace to conceal messages. It does so by appending whitespace to the end of a line. The tool's author suggests that locating trailing whitespace in text files is like finding a polar bear in a snowstorm. This also explains the name of the utility as it exploits the Steganographic Nature of Whitespace (SNOW).

When you encode a message in a text file, the original file remains unchanged and Stegsnow creates an identical file with the same text as the original, along with the hidden message. When you open this new file in a text editor, you only see the text of the original file. You must run the new file through Stegsnow to view the hidden message.

You'll find Stegsnow in the repositories of most popular Linux distros. The utility has been around since the '90s and was last updated in June 2013. Despite its age, Stegsnow is fairly straightforward to use and an easy choice for some harmless fun. But it can just as readily be used to hide important login information or other useful data that you don't want to make readily accessible in an innocuous-looking text file. Run `sudo apt install stegsnow` to install the latest available version if you're running a Debian/Ubuntu or a derivative distro; `sudo dnf install stegsnow` can be run on Fedora and other RPM-based distros.



```
linuxlala@playground:~/Documents/snow-test$ stegsnow -C -f bar.txt anotherfile.t
xt hidden-msg.txt
Compressed by 23.41%
Message used approximately 29.55% of available space.
linuxlala@playground:~/Documents/snow-test$ stegsnow -C hidden-msg.txt
                    _ ._  _ , _ ._
                  (_ ' ( `  )_  .__)
                ( (  (    )   `)  ) _)
               (__ (_   (_ . _) _) ,__)
                   `~~`\ ' . /`~~`
                   ,::: ;   ; :::,
                  ':::::::::::::::'
 _____________jgs______/_ __ \_______________________
|                                                   |
| A predator, terminator and alien walk into a bar. |
|___________________________________________________|
linuxlala@playground:~/Documents/snow-test$ 
```

Hide the contents of a text file in another if the message contains formatting, indentation or ASCII art styling.

Hiding in plain sight

Let's first create a simple text file, with only about three short lines of text:

```
$ cat testfile.txt
Test file to test Stegsnow.
A new line, so there's room for whitespaces.
Another line, because why not.
```

We'll use Stegsnow to hide a short message in this file. The command has a simple syntax, and in addition to the command options expects a source file and an output file. The source file is the text file within which you wish to hide your secret message. The contents of the source file are copied on to the output file, with additional spaces and tabs thrown in to accommodate your secret message.

Stegsnow adds sequences of up to seven spaces, interspersed with tabs, to make room for your secret message. This allows three bits to be stored every eight columns. Naturally, the larger the source text file, the bigger the message that you can hide.

```
$ stegsnow -C -m “hide this” testfile.txt hidden.txt
Compressed by 47.22%
Message used approximately 97.44% of available space.
$ cat hidden.txt
Test file to test Stegsnow.

A new line, so there's room for whitespaces.
Another line, because why not.
$ stegsnow -C hidden.txt
hide this
```

The -C command switch is used to tell Stegsnow to compress the new file, while -m is used to specify the message we wish to hide in the file. Finally, the Stegsnow command expects a source file and a new file into which the secret message will be hidden.

When we view the contents of the hidden.txt file, it appears to be identical to the original source file we used in the command. However, the secret message is revealed when we run the new file through Stegsnow with `stegsnow <command options> newfile`. In our example above, since we used -C to compress the file when creating the new file to hide our message, we must also use -C with Stegsnow to uncompress the new file and view the hidden message.

If you try to add a large message to a shorter source file, Stegsnow adds new lines to the end of the file to make room for your secret message.

```
$  echo “This is a basic text file. We'll use it to test Stegsnow. Let's keep things
```

> "It provides a quick alternative to store secret and important information, such as login credentials, if you don't want to use a dedicated password manager."

```
simple." >> test-file.txt
$ stegsnow -C -m "please hide this text message" test-file.txt not-enough-room.txt
Compressed by 45.69%
Message exceeded available space by approximately inf%.
An extra 5 lines were added.
```

When you open the not-enough-room.txt file in a text editor, you'll find five empty lines at the bottom. This is why it's important to always use a large enough file so as to accommodate your secret message.

Added security

To further safeguard your secret data, you can also encrypt the new file created by Stegsnow with a password. The command `stegsnow -C -m "some message" -p <password> sourcefile outputfile` will help you store "some message" in outputfile, which is encrypted with the specified password. You'll have to run the `stegsnow -C -p <password> outputfile` command to be able to view the hidden message.

```
$ stegsnow -C -p "qwerty" -m "I'm going to hide this very large message in a 900 word text file" anotherfile.txt hideme.txt
Compressed by 42.50%
Message used approximately 22.05% of available space.
$ stegsnow -C hideme.txt
?ho nt*ronnogenhr to. rtanptualesp0+ligt guoa fhoaopftt
$ stegsnow -C -p qwerty hideme.txt
I'm going to hide this very large message in a 900 word text file
```

Without the password, even Stegsnow won't let you read the secret message. Although it adds a layer of security, the disadvantage of using a password should also be obvious. Depending on your chosen shell, terminal emulator and configuration, it'll be quite easy to view the password by accessing the history of previously executed commands. A quick and easy solution is to add a space to the front of the command. This ensures the command isn't stored in the history.

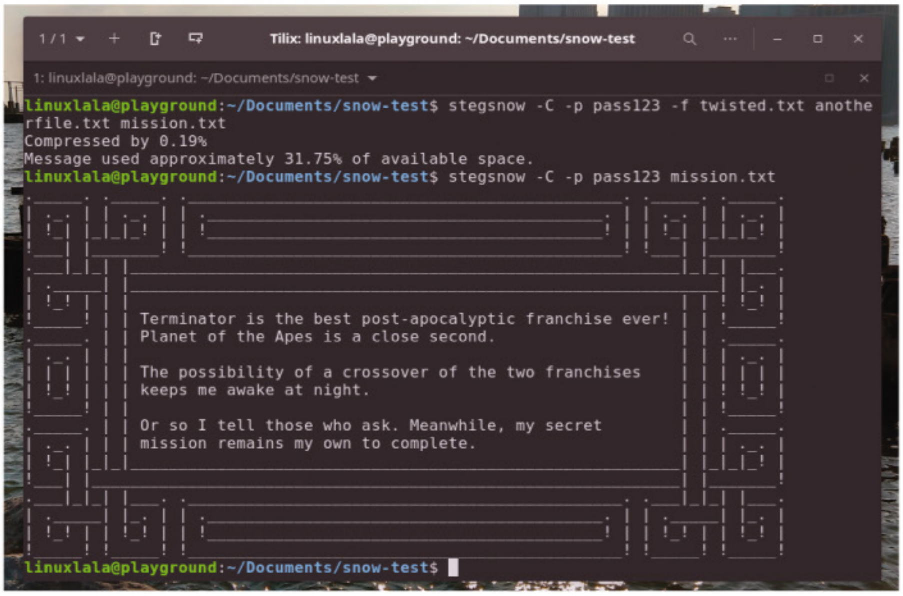
We've so far discussed how to hide basic messages in a text file, but it's also possible to hide an entire text file within another. For this, you must use the -f command option. The `stegsnow -C -f <filename> <sourcefile> <outputfile>` command copies the contents of sourcefile to outputfile; outputfile also contains the entire contents of filename.

```
$ stegsnow -C -f testfile.txt anotherfile.txt final.txt
Compressed by 43.18%
Message used approximately 36.31% of available space.
$ stegsnow -C final.txt
Test file to test Stegsnow.
A new line, so there's room for whitespaces.
Another line, because  why not.
```

You can use the -S option to determine just how much text any given text file can accommodate:

```
$ stegsnow -S anotherfile.txt
File has storage capacity of between 1355 and 1427 bits.
Approximately 173 bytes.
```

Stegsnow is one of the easiest and most readily available steganography tools. It provides a quick alternative to store secret and important information, such as login credentials, if you don't want to use a dedicated password manager – but we wouldn't recommend it for this use case. ■


1 / 1
Tilix: linuxlala@playground: ~/Documents/snow-test
1: linuxlala@playground: ~/Documents/snow-test

```
linuxlala@playground:~/Documents/snow-test$ stegsnow -C -p pass123 -f twisted.txt anothe
rfile.txt mission.txt
Compressed by 0.19%
Message used approximately 31.75% of available space.
linuxlala@playground:~/Documents/snow-test$ stegsnow -C -p pass123 mission.txt

    Terminator is the best post-apocalyptic franchise ever!
    Planet of the Apes is a close second.

    The possibility of a crossover of the two franchises
    keeps me awake at night.

    Or so I tell those who ask. Meanwhile, my secret
    mission remains my own to complete.

linuxlala@playground:~/Documents/snow-test$
```

A quick internet search revealed several utilities hosted on GitHub that claim to be able to brute-force the password encryption.

IMAGE AND AUDIO FILE STEGANOGRAPHY

As convenient as it may be to use Stegsnow to hide text messages in text files, it's just as easy to use image and audio files to store secret messages. Released under the GPLv2 licence, Steghide (**https://steghide.sourceforge.net**) lets you hide text files in JPG and BMP image and WAV audio files. Most distros offer Steghide in their software repositories.

As with Stegsnow, Steghide also offers compression and password encryption. We recommend you take some time to read through the man pages of both these utilities to better understand their features and capabilities.

Run `steghide embed -cf <filename.jpg> -ef <somefile.txt>` to hide the contents of the specified text file in the specified image file. The -cf option is used to provide the cover file that will be used to hide the text file, which is specified with -ef; `steghide extract -sf <filename.jpg>` can be used to extract the hidden file, which is stored in the current working directory.

```
$ steghide embed -cf bridge-seas.jpg -ef bar.txt
Enter passphrase:
Re-Enter passphrase:
embedding "bar.txt" in "bridge-seas.jpg"...
embedding "bar.txt" in "bridge-seas.jpg"... done
$ steghide extract -sf bridge-seas.jpg
Enter passphrase:
wrote extracted data to "bar.txt"
```

The `steghide info <filename.jpg>` command can be used to view details about the hidden file.

Unlike Stegsnow, Steghide overwrites the original image file and uses a password by default to encrypt the data.

Phone & tablet tips

Brilliant things to do on your device.

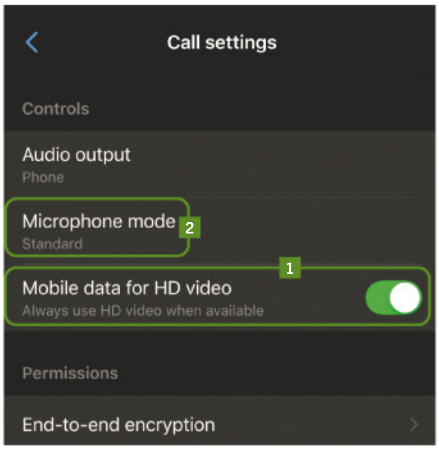
ANDROID & iOS

Enhance your video calls in Messenger

After focusing most of its attention on WhatsApp in 2024 (see next tip), Meta has added several useful features to its other messaging app, Messenger. These mainly focus on making your video calls “easier, more reliable and more fun”.

For starters, all video calls made over Wi-Fi now use HD by default to provide a higher-quality picture. To use HD over a mobile connection too, tap the three-dot menu in the top-right corner of a Messenger call, choose ‘Call settings’ and switch on ‘Mobile data for HD video’ (1 in our screenshot below).

To improve the audio quality as well, tap ‘Microphone mode’ 2 and switch on ‘Voice isolation’. This will reduce background noise so the other person can hear you more clearly.


Call settings

Controls

Audio output
Phone

Microphone mode 2
Standard

1
Mobile data for HD video
Always use HD video when available

Permissions

End-to-end encryption

Another useful new option lets you leave voice or video messages when someone doesn’t answer your call. Tap the ‘Record message’ button to capture your audio or video message, then press Send.

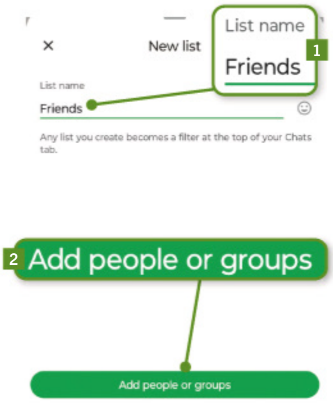
Finally, Meta will soon introduce AI backgrounds that let you personalise your Messenger video calls with colourful themes. Once the feature is available, tap the Effects (smiley-face) icon during a call, select Backgrounds and either choose one of the AI images or enter a text prompt to generate your own.

ANDROID & iOS

Organise WhatsApp contacts into lists

Back in August 2024, WhatsApp added the option to save contacts as ‘favourites’, so you can message and call them more quickly. It has now introduced a follow-up feature called Lists, which lets you organise people into themed lists such as Friends, Family and Neighbours.

Your lists join existing filters at the top of WhatsApp’s Chats tab – including Unread, Favourites and Groups – so that tapping one shows only conversations with the people in that list. To create a list, tap the plus-sign button to the right of the other filters to open the ‘New list’ panel.


New list

List name
Friends

1

Any list you create becomes a filter at the top of your Chats tab.

Give your list a suitable name (1 in our screenshot left), then press the ‘Add people or groups’ button 2 and select the contacts you want to add to the list. Tap the green tick button to save your list and it will appear in the filter bar at the top of the Chats tab.

To change the name of a list, or to add and remove people, long-press its filter and choose Edit. You can create as many lists as you want, and deleting them won’t affect the contacts or chats they contain.

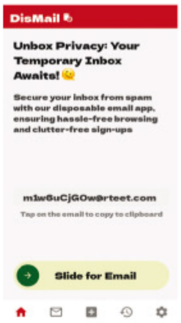
ANDROID & iOS

View your recent listening history in Spotify

Spotify has introduced a new feature called Recents, which lists all the songs, podcasts and audiobooks you’ve listened to over the last 90 days. This replaces the old Listening History option and will prove useful for “picking up a paused podcast, finding last week’s earworm or

Best new apps What you should install this month

DISMAIL


DisMail

Unbox Privacy: Your Temporary Inbox Awaits!

Secure your inbox from spam with our disposable email app, ensuring hassle-free browsing and clutter-free sign-ups

m1w6uCjGOw@rteet.com

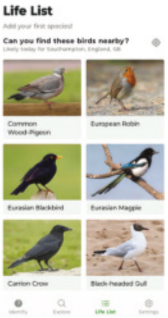
Tap on the email to copy to clipboard

Free

Android tinyurl.com/APC543dis

DisMail generates temporary email addresses you can use to register with websites and apps. This keeps your real address private and prevents spam. To create a fake email address, simply slide the green button and copy the result to your clipboard. Emails are sent to your DisMail Inbox, so you can verify account sign-ups.

MERLIN BIRD ID


Life List

Add your first species!

Can you find these birds nearby?

Likely today for Southampton, England, GB

Free

Android tinyurl.com/APC543bird

iOS tinyurl.com/APC543birdio

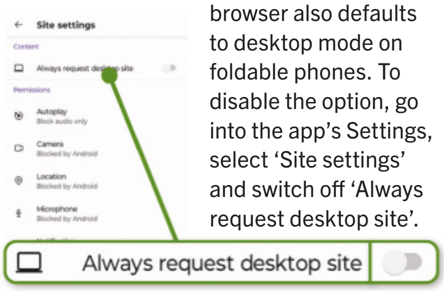
This brilliant free app for identifying birds from photos and sounds has been updated with some new features. Its ‘Life List’ tab, which stores details of birds you’ve identified, now suggests species to look out for in your area, while its Explore tab now provides images of every bird. Merlin has also improved its photo identification.

FIREFOX FOR ANDROID TABLETS

Free

Android tinyurl.com/APC543ffox

Firefox for Android tablets now automatically loads the desktop versions of websites – rather than pared-down mobile sites – to make full use of the larger screen. The browser also defaults to desktop mode on foldable phones. To disable the option, go into the app’s Settings, select ‘Site settings’ and switch off ‘Always request desktop site’.


Site settings

Content

Always request desktop site

Permissions

Autoplay
Block audio only

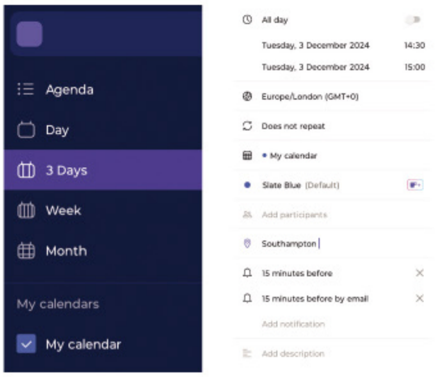
Camera
Blocked by Android

Location
Blocked by Android

Microphone
Blocked by Android

*Contains in-app purchases

Best apps for... Updating your calendar in 2025


Agenda
Day
3 Days
Week
Month
My calendars
My calendar
All day
Tuesday, 3 December 2024 14:30
Tuesday, 3 December 2024 15:00
Europe/London (GMT+0)
Does not repeat
My calendar
Slate Blue (Default)
Add participants
Southampton
15 minutes before
15 minutes before by email
Add notification
Add description

PROTON CALENDAR

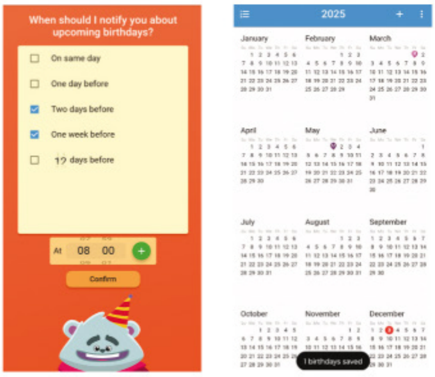
Free*

Android tinyurl.com/APC543pro

iOS tinyurl.com/APC543proio

Proton Calendar is a private alternative to Google Calendar that protects your events using end-to-end encryption. You can switch between day, three-day, week and month views, and light and dark modes. The Android app can display your schedule in a widget on your home screen – a feature coming to the iOS version soon.

Best for: Encrypting your calendar


When should I notify you about upcoming birthdays?
☐ On same day
☐ One day before
☑ Two days before
☑ One week before
☐ 12 days before
At 08 00
Confirm
2025
January
February
March
April
May
June
July
August
September
October
November
December
1 birthdays saved

BIRTHDAY CALENDAR REMINDER

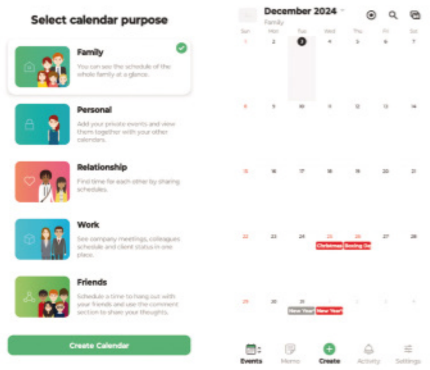
Free*

Android tinyurl.com/APC543birth

iOS tinyurl.com/APC543birthio

Ensure you don't miss anyone's birthday in 2025 by installing this calendar/reminder app. Import birthday info from your contacts, existing calendar or a CSV or XLSX file, and choose when you want to be reminded, such as on the day or weeks in advance. You can also add birthdays manually.

Best for: Getting birthday reminders


Select calendar purpose
Family
Personal
Relationship
Work
Friends
Create Calendar
December 2024
Family
Events
Memo
Create
Activity
Settings

TIMETREE

Free*

Android tinyurl.com/APC543time

iOS tinyurl.com/APC543timeio

TimeTree is a popular shared-calendar app, which helps you keep family, friends and work schedules in sync. It lets you create and join multiple calendars for different purposes, receive notifications for new and updated events, and chat within events to confirm the details. You can also access your calendars in a web browser.

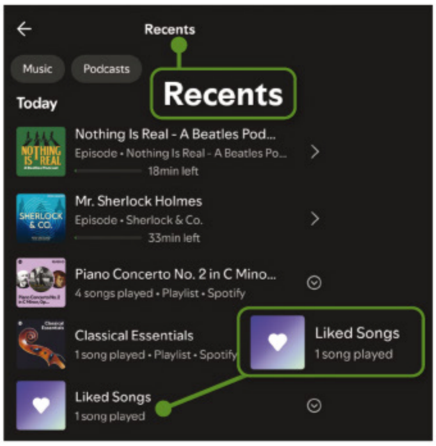
Best for: Managing multiple calendars

---

finally playing that saved album or audiobook".

To access Recents in the Spotify app for Android (**tinyurl.com/APC543recent**) or iOS (**tinyurl.com/APC543recentio**), tap your profile picture in the top-left corner and select Recents. All the music, podcasts and audiobooks you've played or saved over the past three months will be listed in reverse-chronological order, so you can tap them to resume listening. The Recents entries include tracks from playlists and Liked Songs (see screenshot above) that played in Spotify's Shuffle mode.

Unusually for Spotify, the new Recents feature is available to both free and Premium users.


Recents
Music
Podcasts
Recents
Today
Nothing Is Real - A Beatles Pod...
Episode • Nothing Is Real - A Beatles Po...
18min left
Mr. Sherlock Holmes
Episode • Sherlock & Co.
33min left
Piano Concerto No. 2 in C Mino...
4 songs played • Playlist • Spotify
Classical Essentials
1 song played • Playlist • Spotify
Liked Songs
1 song played
Liked Songs
1 song played

ANDROID

Send Gmail messages to multiple recipients

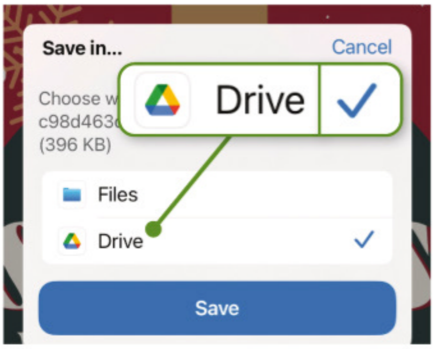
Google has made a small but useful improvement to the Gmail app for Android, to make it easier to send emails to multiple recipients. Previously, when you wanted to copy people into a message, you needed to manually enter their email addresses in the 'Cc' (carbon copy) field – or the 'Bcc' (blind carbon copy) field to hide their details from other recipients.

In the updated Gmail app, you can just drag and drop a contact's name or an email address from the 'To' field to 'Cc' (see screenshot below) or 'Bcc' – or vice versa. The two carbon-copy fields will open automatically when you long-press a recipient's name or email, so you can address the message correctly with minimal typing.

iOS

Download files to Google Drive

Google has updated the iOS version of its Chrome browser (**tinyurl.com/APC543chrome**) with the option to save files directly to Google Drive rather than download them to your device. It says this will help you save space on your iPhone or iPad, though curiously it doesn't offer the feature in the Android version of Chrome.


Save in...
Cancel
Choose w
c98d463
(396 KB)
Drive
Files
Drive
Save

To save a file from Chrome to Google Drive, select the Drive option (see screenshot left) after tapping the Download button and choose your Google account. Downloaded items will be saved to a new folder in Google Drive called 'Saved from Chrome'. Additionally, if you have Google Photos installed on your iPhone or iPad, you can save images from websites directly to that app. Simply long-press a picture you're viewing in Chrome and select 'Save in Google Photos'. ■

Capture images and video with Picamzero

Les Pounder rarely smiles for the camera, but by using Picamzero we may have just turned that frown upside down…

YOU'LL NEED
- A Pi 3,4 or 5
- Pi Camera 1 or 2 (not 3)
- PIR sensor
- 3x F2F jumper wires
- Code: **https://bit.ly/lxf324code**

Using the Raspberry Pi camera isn't too difficult, but many of us are experienced coders. What if we were new to coding and to the Raspberry Pi camera, or perhaps a child in school? Could we handle rpicam apps and Picamera2? Chances are we couldn't, so Raspberry Pi has released Picamzero (tinyurl.com/APC543picam), a simple Python module that follows GPIO Zero, and GUI Zero. Picamzero offers an easier-to-use interface that may not have all of the features of the other modules, but it has enough to get the job done.

Set up the Pi Camera

Picamzero does not have any means to autofocus the camera, so it can work with the Raspberry Pi Camera 3, but you can't change the focus. Use a fixed-focus model (Cam 1 or Cam 2) instead. The Raspberry Pi Camera connects to the CSI (Camera) port on the older models of Pi, for the Pi 5 it connects to CAM0 and requires a different cable. With the Pi powered off, carefully unlock the plastic guard on the Camera port and connect the cable with the teeth facing the Ethernet/USB ports on the Pi. Then lock the plastic guard to grip the cable. The camera end of the cable should be connected, if not, unlock the guard, insert the cable so the teeth of the cable match the teeth of the connector. Then lock the cable in place. Connect your peripherals and power up the Pi to the desktop. Before we run any Python code, open a terminal and run this command to check that the camera is working:

```
$ rpicam-hello
```

You should see a preview, proving the camera works. If not, power off and check the connections.

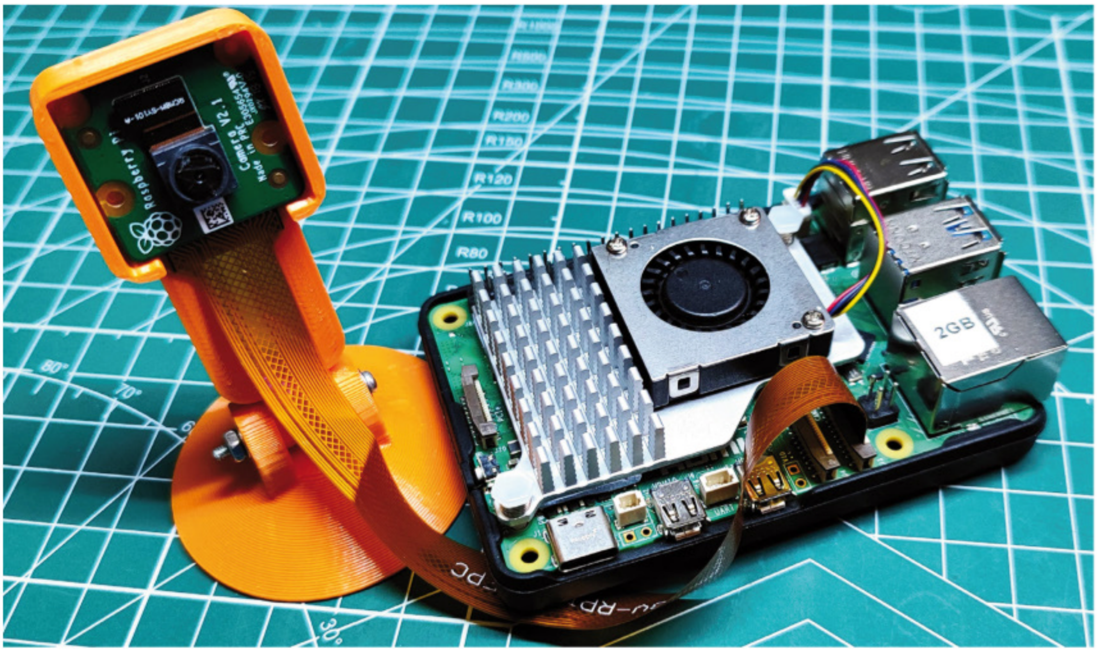
Project 1: Hello World

The first test is the ubiquitous Hello World, but this time we're taking a picture with the current time as the filename. From the Raspberry Pi menu, click on Programming and select Thonny. Create a new blank file, and start by importing some modules. The first is Picamzero, specifically the Camera features. Then we import gmtime (formatting time to UTC), strftime (formatting time into a string) and sleep (pauses code):

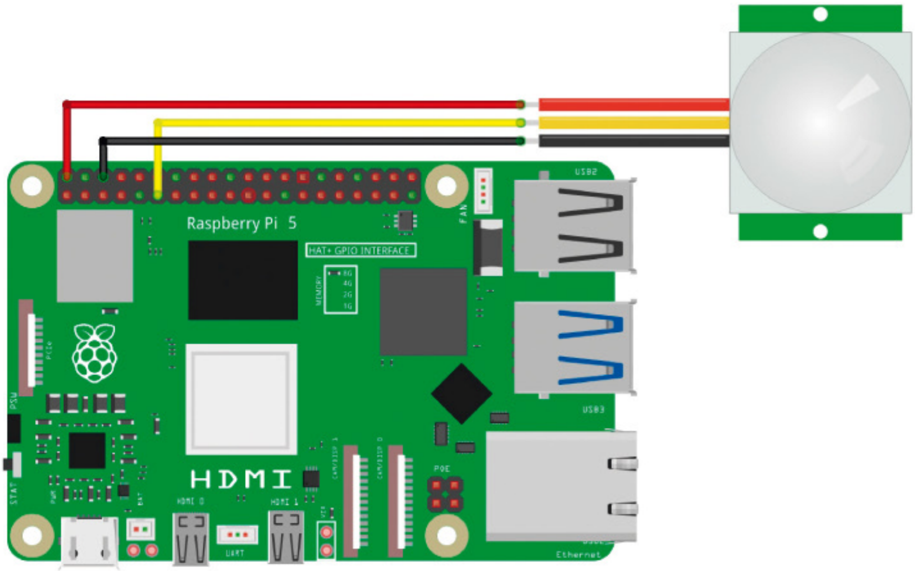
```
from picamzero import Camera
from time import gmtime, strftime, sleep
```

We create an object called cam. This makes it easier to work with the Camera module. Using the cam object, we start a preview window so that we can frame the shot:

```
cam = Camera()
cam.start_preview()
```



The older Raspberry Pi Cameras are ideal for Picamzero because they are cheap and plentiful – just the thing for educational users.



This project sees a PIR sensor being used to trigger the camera to take a timelapse.

A short two-second pause gives us just enough time to frame the shot. Change the value to give yourself more time:

```
sleep(2)
```

Using the cam object, we take a photo, using strftime to format the time into YY-MM-DD HH-MM-SS and then appending the .jpg file extension. Lastly we close the preview to show the picture has been taken:

```
cam.take_photo(strftime(“%Y-%m-%d
%H:%M:%S”, gmtime())+”.jpg”)
cam.stop_preview()
```

Save the code as project1.py and click on the green run button to start, but be quick as you only have two seconds to get yourself in the photo. Open the Raspberry Pi OS File Manager, and the image will be saved into the same directory as the project1.py file.

Project 2: Record a video

Our second project is a mere demonstration to show that Picamzero can record video. First we import the Picamzero module, then we create the same cam object to make it easier to work with the module:

```
from picamzero import Camera
cam = Camera()
```

We then start a preview window, and immediately record a five-second video with the filename test.mp4. When the recording is done, the preview window closes to indicate that the code is finished:

```
cam.start_preview()
cam.record_video(“test.mp4”, duration=5)
cam.stop_preview()
```

Save the code as project2.py and click on the green run button to start. Record the video, then open the video using VLC via the File Manager.

Project 3: Timelapse camera

We've made a few timelapse videos and the biggest issues we faced were recording the images as sequential files, then merging the images into a video file. Picamzero does all of that in five lines of code!

Once again we import the Picamzero module and create the cam object:

```
from picamzero import Camera
cam = Camera()
```

Start a preview window, and then start the capture sequence, which uses the filename of sequence.jpg and there are 10 images in the sequence, each with a one-second gap between them. The final part of this line makes the video from the image sequence. The filenames for the images in the sequence are sequence1.jpg, incrementing to sequence10.jpg in this example. The final line closes the preview to show that the code is done running:

```
cam.start_preview()
cam.capture_
sequence(filename=”sequence.jpg”,
num_images=10, interval=1, make_
video=True)
cam.stop_preview()
```

Save the code as project3.py and click on the green run button to start. The code takes 10 photos, saving them to the directory. Once all the images are taken, the code makes a video, which you can find via the File Manager, and play in VLC.

Project 4: Sensor-triggered timelapse

This project is where we take the base code for project 3 and make it into a useful application that uses a PIR motion sensor to trigger the camera to take a sequence of images and make a video of them. For the GPIO connection, our PIR sensor connects to 5V, GND and GPIO 17. Please see the high-resolution diagram in the download (**https://bit.ly/lxf324code**) for this tutorial. The GPIO Python module we're using is GPIO Zero as it is extremely easy to use.

In Thonny, create a new file and import the Picamzero module, then import the MotionSensor class from gpiozero, then the time module's various elements to get the current date and time:

```
from picamzero import Camera
from gpiozero import MotionSensor
from time import gmtime, strftime, sleep
```

Create two objects, the first is pir, used to link the Python code to the PIR sensor on GPIO 17. The cam object is used again:

```
pir = MotionSensor(17)
cam = Camera()
```

We need a function (lines of code that are called when the function name is used) to run the timelapse process. Call the function timelapse.

```
def timelapse():
```

In the function, print that the sensor has been triggered, then create the image sequence filename using the date and time. Then start a preview window:

```
  print(“Sensor triggered”)
  filename = strftime(“%Y-%m-%d
%H:%M:%S”, gmtime())
  cam.start_preview()
```

Still in the function, capture the image sequence, using the filename object, and appending the .jpg file extension. There are 10 images, with one second between images. The code also makes the sequence into a video:

```
  cam.capture_
sequence(filename=filename+”.jpg”,
num_images=10, interval=1, make_
video=True)
```

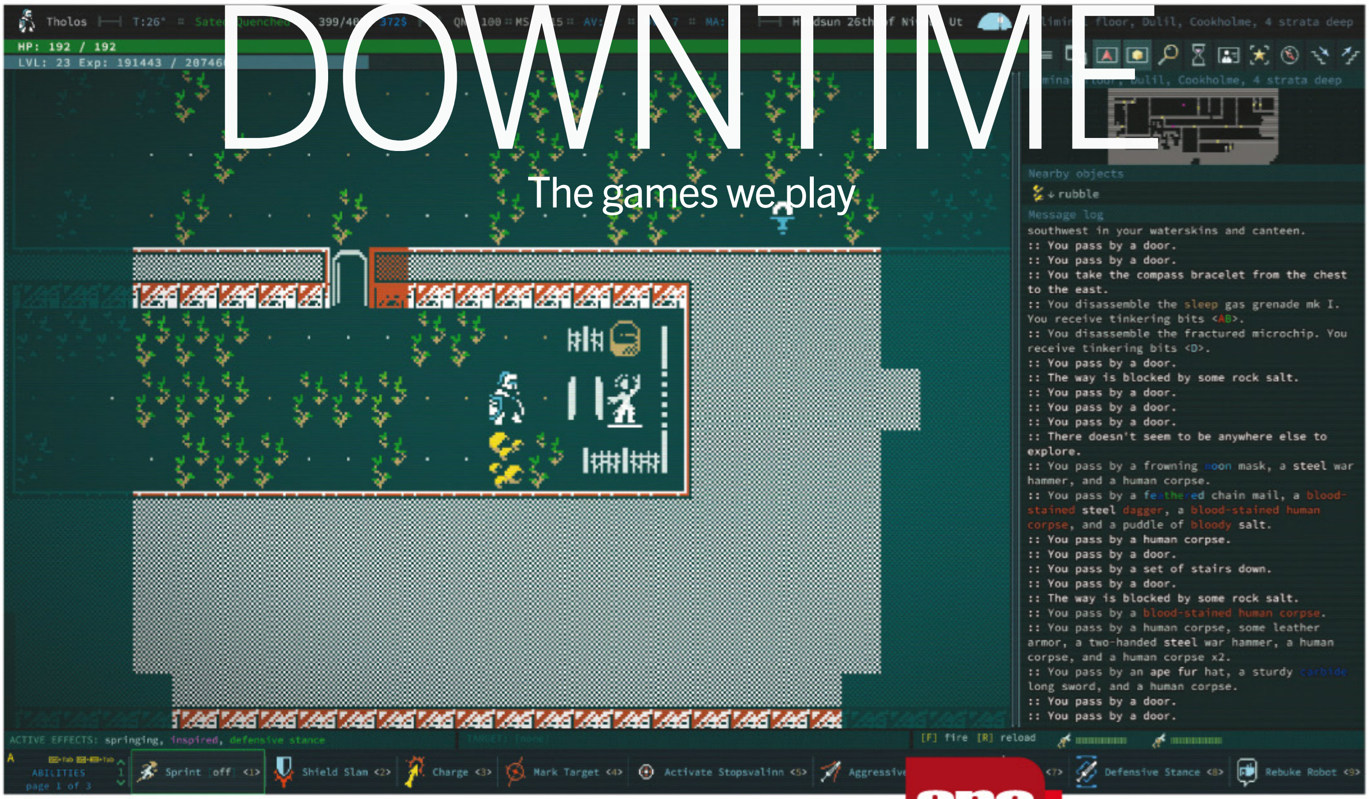
We now leave the function and start a while True loop to continually run the code within it. The first line in the loop prints 'Waiting for the sensor to be triggered'. The next line runs the timelapse function when the PIR motion sensor is triggered. Finally a one-second sleep prevents the loop from stressing the CPU too harshly:

```
while True:
  print(“Waiting for sensor to be triggered”)
  pir.when_motion = timelapse
  sleep(1)
```

Save the code as project4.py and click on the green run button to start. Wave your hand in front of the sensor to trigger the timelapse sequence. The image sequence and video can be found in the same folder as the project code. The video can be opened in VLC. ■

DOWNTIME

The games we play



```
southwest in your waterskins and canteen.
:: You pass by a door.
:: You pass by a door.
:: You take the compass bracelet from the chest
to the east.
:: You disassemble the sleep gas grenade mk I.
You receive tinkering bits <AB>.
:: You disassemble the fractured microchip. You
receive tinkering bits <D>.
:: You pass by a door.
:: The way is blocked by some rock salt.
:: You pass by a door.
:: You pass by a door.
:: You pass by a door.
:: There doesn't seem to be anywhere else to
explore.
:: You pass by a frowning moon mask, a steel war
hammer, and a human corpse.
:: You pass by a feathered chain mail, a blood-
stained steel dagger, a blood-stained human
corpse, and a puddle of bloody salt.
:: You pass by a human corpse.
:: You pass by a door.
:: You pass by a set of stairs down.
:: You pass by a door.
:: The way is blocked by some rock salt.
:: You pass by a blood-stained human corpse.
:: You pass by a human corpse, some leather
armor, a two-handed steel war hammer, a human
corpse, and a human corpse x2.
:: You pass by an ape fur hat, a sturdy carbide
long sword, and a human corpse.
:: You pass by a door.
:: You pass by a door.
```

Statues of ancient sultans give valuable historical clues.

PRICE $39.99 **PLATFORM** PC, Mac, Linux, Android **WEB** www.cavesofqud.com

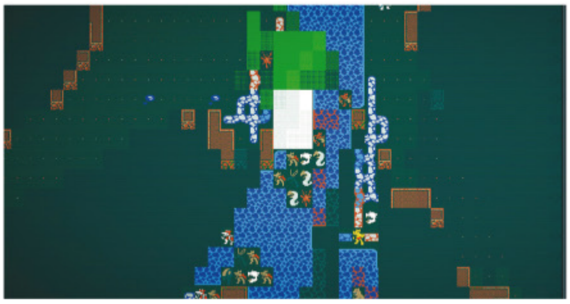
apc EDITOR'S CHOICE

Caves of Qud

An epic science-fantasy RPG.

***Caves of Qud* is a traditional roguelike RPG in form, a top-down, turn-based game that relies on text and simple-yet-evocative graphics to convey its world. It doesn't stick hard and fast to permanent death, though, instead letting you choose whether you want save points and even tweak how much fighting you'll have to do. Nor does *Qud* stick hard and fast to the traditional roguelike rules of having an opaque, frustrating user interface and arcane, entirely keyboard-driven control scheme – it even plays very well on a mobile PC like the Steam Deck.**

You make your character from a variety of archetypes that describe teched-up normal humans or the far more numerous mutant inhabitants of Qud. You then build in a relatively freeform way, choosing new skills, upgrading your abilities and gathering equipment for a dizzying array of possibilities. From there you set off across Qud from your starting village in true RPG sandbox fashion, choosing to follow or not follow the many quests and whimsical distractions you may come across. A lot of that will involve carefully delving into the ruins of the ancient civilisation of the Eaters of Earth, fighting the creatures you find there, and pilfering their treasures.



A thermal grenade in a river makes an impromptu mist screen.

Each playthrough has the same world map but randomises nearly every local area according to a complex system of generated histories chronicling the sultans who ruled Qud in ages past.

The big-idea, high-weirdness science-fantasy world of Qud's far future is of an old genre (think *Dune*) with its own tropes, such as influence from ancient cultures and mythology, but one that's so underutilised in videogames that the setting comes off as refreshing. The spires of humanity's ruined past sit below and on top of Qud, forming a layer cake of dungeons filled with objects from a civilisation so outrageously advanced that they invented teleportation and mined the neutron-degenerate matter at the heart of dead stars.

The main quest takes you on a journey well-suited to pit stops, dotted with odd characters such as a deaf-mute albino bear-porcupine gunsmith and a very rude talking fungus you have to bring with you by letting it grow on your skin. It also stays varied: you'll delve ancient ruins for lost technology, yes, but also manage diplomacy among factions, make friends, solve riddles, and unpick that generated history. All of this is written in a prose so flowery and rich that it passes beyond purple and arrives in the same place as something like Lewis Carroll's Alice's Adventures in Wonderland.

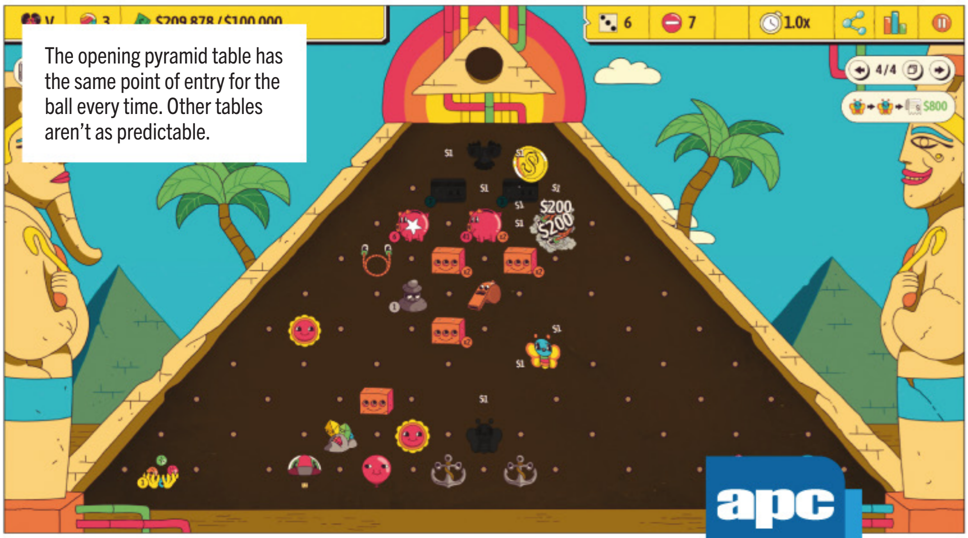
For some who have not played games like this before, simply the act of learning to control and manoeuvre your character will be frustrating. Despite this I cannot recommend *Caves of Qud* enough for its innovations in mechanics and storytelling, however anachronistic it may look.

VERDICT

★★★★½

Caves of Qud is a genre-defining achievement in play, story and roleplaying freedom.

Jonathan Bolding



The opening pyramid table has the same point of entry for the ball every time. Other tables aren't as predictable.

PRICE $12.34 **PLATFORM** PC **WEB** ballionaire.net

Ballionaire

A Pachinko deckbuilder with a joyous spring in its step.

Ballionaire is a twist on pachinko that adds roguelike deckbuilding elements. Essentially *Peggle* has gone to college, smartened up and gotten itself a master's degree in compelling strategy gameplay.

The goal is to make enough money to pay a tribute that has to be cleared every seven balls. The starter tribute is $500, which is worrying, because the board is initially a complete tightwad. Hitting these pegs pays out a pathetic one dollar apiece. Luckily, after every ball you get a choice of three obstacles that you can add to the table. A trampoline will pay out $200 if you hit it and bounce the ball upwards. A smiling tree will also pay out $200, but only if you hit it from the bottom up. Ah, but as an apology for that irritating caveat, the tree also gains a small multiplier bonus after every single ball played, meaning it can become a substantial payout in the late game.

Oooh, hang on! If I place the trampoline ball under the tree, I'm far more likely to get that lovely multiplier money. And naturally this kind of synchronicity is what you're aiming for with every ball you place on the table. Some balls are 'droppers' which means they'll drop another ball when you hit them. These pair well with 'holders' that will hold onto any balls that hit them and give some lovely bonus in return. The trick here is to put together a Heath Robinson machine so sophisticated that any randomness doesn't stand a chance.

There are five difficulties, with the highest forcing you to place horrible annoyances on your lovely table. One has to be hit 500 times before the end of the game, or you lose. I love these bastards. Worrying about them while also still trying to hit those required tributes is a great, tricky balancing act.

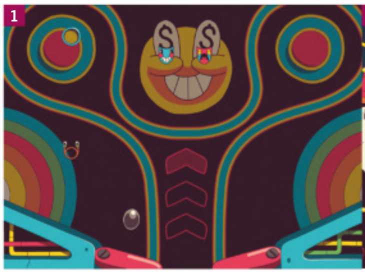
It's a marvellous start to a year that follows the launch of the almighty *Balatro*, and with a few updates this could easily become my new podcast game of choice.

VERDICT

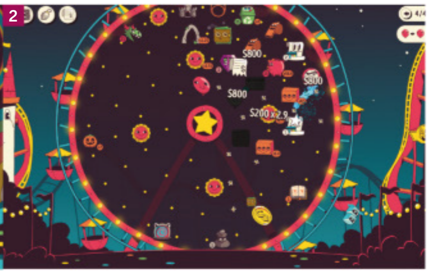
★★★★☆

Ballionaire is a pachinko-roguelike that properly rewards strategic play. Terrific fun indeed.

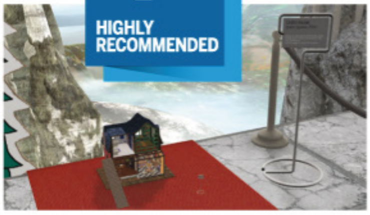
Abbie Stone

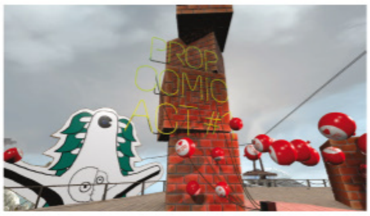


1 The pinball table, with its finite-use flippers, is the best of the bunch.



2 Trust me when I say the Deathwheel stage has been named with no hyperbole whatsoever.





PRICE Free **PLATFORM** PC, MAC
WEB tinyurl.com/APC543zium

THE ZIUM EXPOSITION

A GALLERY WITH A VIEW.

The Zium Exposition is an interactive gallery mixing traditionally flat pictures, animated 3D sculptures and, excitingly, more interactive pieces, which whisk you off to separate worlds for more involved, enclosed experiences.

Zium embraces exploration firstly by including artwork that you can physically step inside, or that turns its head to admire you, or that you can scatter without worrying about paying for breakages. Then there are the pieces in which you're an active participant. Doll's House by Quinn Spence shrinks you down to the size of a borrower, so you can have a proper gander at a doll's house, while Dog Castle by Nomi and Horatiu Roman gives you a janky dog companion that follows you around. Other pieces in the exhibition transport you to separate environments.

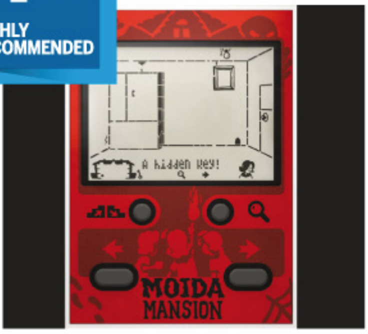
Wonders abound in this digital exhibition that makes the most of its format – but my favourite thing has to be the setting itself. It's half Bond villain lair and half City 17: a former mine and quarry that has been transformed into a brutalist structure to house interactive art.

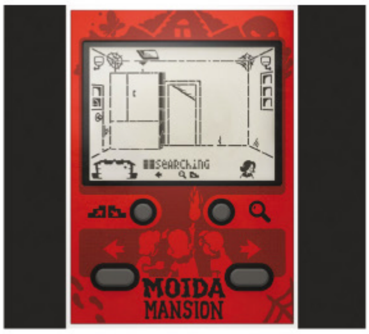
VERDICT

★★★★☆

A fascinating space filled with inventive, interactive exhibits. Touching the artwork is very much encouraged here.

Tom Sykes





PRICE Free **PLATFORM** browser
WEB dukope.itch.io/moida-mansion

MOIDA MANSION

LCD IS BACK (AGAIN).

Following on from *LCD, Please* – Lucas Pope's painstakingly authentic LCD demake of his game *Papers, Please* – comes a brand new game from Pope that offers more morally straightforward fun. *Moida Mansion* is a game about exploring a mansion and trying to rescue your friends while a monster stalks you. My main thought while playing was quite how much I would have enjoyed this, if it had existed as a real LCD game. After entering a randomly generated mansion, you're tasked with looking out for clues and searching every room until you find your friends, while a monster shows up like clockwork to hassle you. When it does, you have to flit from room to room until it disappears. The monster itself is a hilarious, Scooby Doo-esque creation, popping up after every search in the most ridiculous places. There's a funny, cosy vibe that manifests in its every element, from the goofy monster sprites to the beeps that are the sound effects.

VERDICT

★★★★☆

A charming and delightful secret-laden throwback.

Tom Sykes

A great moment marred by a wonky puzzle.

PRICE $18.95 **PLATFORM** PC **WEB** tinyurl.com/APC543mouth

Mouthwashing

My new feel-bad favourite horror game.

I played *Mouthwashing* entirely in one sitting and had to lie down for a while afterward to recover. I felt vile, unsettled at what I'd seen over the previous three hours. *Mouthwashing* is about as classic a walking simulator as you can get mechanically, and while its stabs at more intensive gameplay fall a little flat for me, its narrative, vision, and atmosphere make it one of this winter's standouts, a people's champion of indie horror for very good reason.

The game begins with you playing as Captain Curly of the long haul delivery space ship Tulpar, purposefully setting the vessel on a collision course with an asteroid. After crash landing, the ship is compromised while Curly is horrifically maimed and burned in the crash, leaving him unable to speak but still painfully aware of everything around him.

Mouthwashing swaps between Curly's perspective before the crash and first mate/acting captain Jimmy's after. The Tulpar is an incredible environment, strangely homey before the crash despite the omnipresent motivational posters from Amazon-esque employer Pony Express. The Tulpar's full of great clutter and character details to make it feel lived-in.

A crew meeting shortly after the crash.

There's nothing supernatural about the horror in *Mouthwashing*, just the brutal fallout of a human drama downstream from capitalism. It's a story about how a life without a future makes someone sour, the small joys and overwhelming horror to be found in shit work, and how even the worst circumstances don't necessarily make one's actions sympathetic or justified.

For the most part, *Mouthwashing* has very straightforward problem solving: finding various forms of key to open various forms of lock. Tactile little interactions with the mouse are used to great effect: the way you have to click around to pry open Curly's jaw and feed him painkillers is a brilliant mechanic that's gruesomely echoed in various scenes throughout the game.

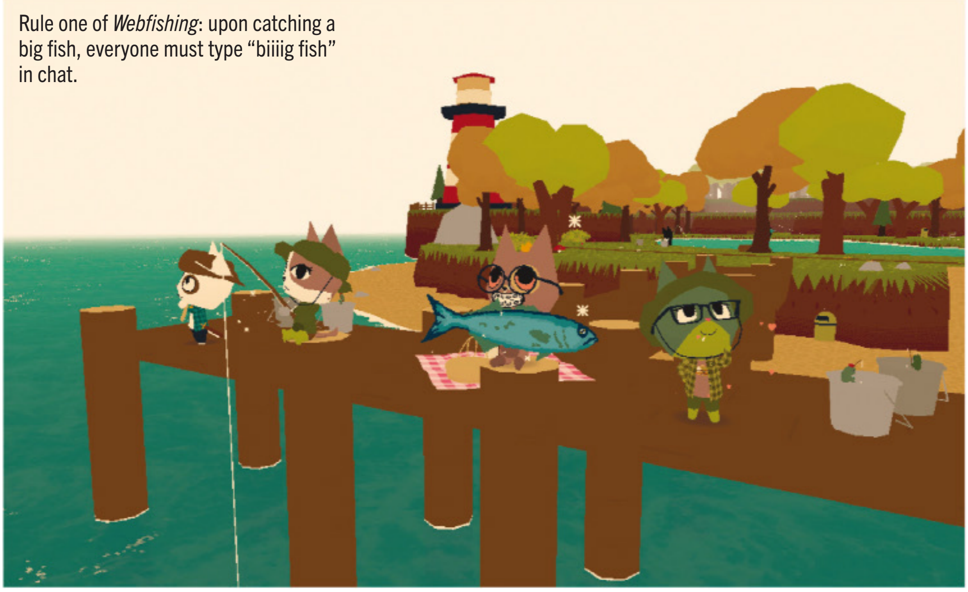
In terms of atmosphere and narrative – the most important parts of a narrative adventure – *Mouthwashing* is a home run.

VERDICT

★★★★☆

Mouthwashing is my favourite horror game of recent times, and has one of the best narratives, period.

Ted Litchfield



Rule one of *Webfishing*: upon catching a big fish, everyone must type “biiiig fish” in chat.

PRICE $7.50 **PLATFORM** PC **WEB** webfishing.net

Webfishing

A fantastic throwback to old-school chatroom games.

The constant search for nostalgia often ends in disappointment, but *Webfishing* is different. It’s managed to capture things I loved so dearly about the bizarre social chatroom games of the 2000s – Habbo Hotel, IMVU, Gaia Online – while cultivating the kind of community I never really found in those older romps.

Mere minutes into booting up *Webfishing*, and I knew I was stumbling into something special. It’s crunchy-looking in all the right ways, sporting a pixelated, low-polygon art style reminiscent of earlier *Animal Crossing* games. Playing alone is fun in its own right. It’s good for when I feel like exploring *Webfishing*’s small island with all its nooks and crannies, doodling on the floor with some chalk or simply needing a chat-free fish. But *Webfishing*’s magic comes from throwing my hook out alongside other rod-wielding cats and dogs that are there. *Webfishing*’s focus on casting your line and the quiet serenity between catches is the perfect vessel to start chatting with other folks in the lobby. I’ve yet to come across a lobby full of players who I couldn’t get along with. The actual fishing itself is a lovely experience, too. I’m able to cast my line out anywhere I please, which is something I appreciate. No walking around every body of water looking for vaguely fish-shaped silhouettes or perfect rippling circles of aquatic activity.

It means I can pick a spot, set my character down and stay there for hours if I wanted to. No fighting with other players for prime catch spots, and no endlessly wandering around. I would regularly find groups all piled together at the ocean dock, peacefully fishing side by side. The act of reeling in a fish is relatively simple – wait for a bite, and then a screen pops in where I have to fill a bar while breaking through certain hurdles.

The game is small in scope, yet I’m still finding new things to do and places to explore. and I imagine I’ll be diving into *Webfishing* for many months to come.

VERDICT

★★★☆☆

Webfishing is a delightful dose of chatroom nostalgia and a cosy fishing experience.

Mollie Taylor

1 Laying out various props to carve out your own space is one of the smaller joys in this game.

2 Fishing is more fun with friends.

Well, suppose we're both prisoners

apc HIGHLY RECOMMENDED

PRICE Free **PLATFORM** PC, browser
WEB tinyurl.com/APC543anch

THE ANCHORITE

ESCAPE A TOWER IN THIS TWISTY ADVENTURE GAME.

You’ve been locked in a tower for the good of the kingdom in this interactive adventure, which wouldn’t feel out of place as an episode of *The Twilight Zone*. This is another example of a short, twisty story told in the adventure game format – one of the best trends of recent years.

Your initial goal is not to escape, but initially to do just what is asked of you, by a disembodied voice speaking outside your door. There isn’t much going on in your three small rooms. You’ve been illuminating a manuscript, but sometimes your clothes need washing, or you run out of ink, and all these problems require a bit of thought and a spot of item-combining as in the classic adventure games. Over several days your peaceful retreat gets less serene, like that time a skeleton appears outside your window.

It’s down to the well-paced storytelling, but also the quality of the artwork, which really sells the nature of the shift with its luxurious pixel art and animation.

VERDICT

★★★★☆

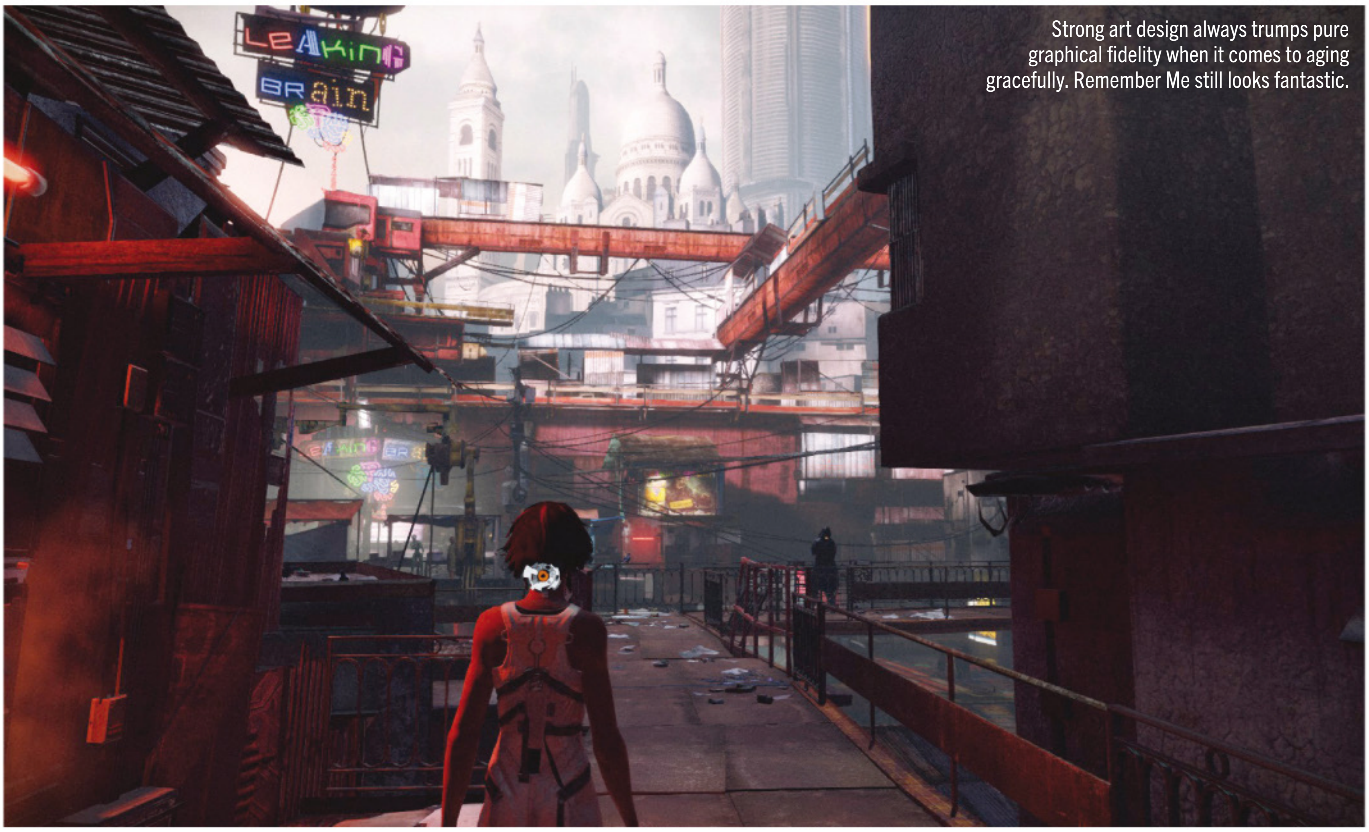
A great entry in a trend that keeps on spitting out memorable stories.

Tom Sykes

GAME CHANGER

Old games, new perspectives

MEMOREYES
CAP. TRACE GABRIEL



Strong art design always trumps pure graphical fidelity when it comes to aging gracefully. Remember Me still looks fantastic.

RELEASE June 3, 2013 **DEVELOPER** Dont Nod Entertainment **PUBLISHER** Capcom **LINK** dont-nod.com

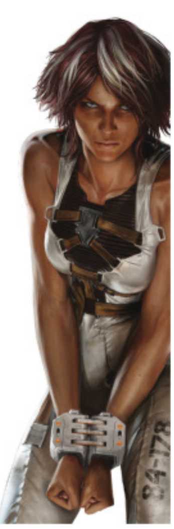
Remember Me

Robin Valentine takes a melancholy trip down memory lane.

Poking fun at forgotten brawler *Remember Me*'s name is low-hanging fruit, but it's hard to get anywhere in this tale without acknowledging the irony. These days, developer *Don't Nod* is instead remembered primarily for the first two Life is Strange games. *Remember Me* is lucky to be a footnote.

In retrospect the studio's debut game seems like the truest expression of its original identity – creative, stylish, off-kilter and so French. But its middling reception and disappointing sales left the company in dodgy financial straits that only *Life is Strange* saved it from, ensuring it would never get a sequel, direct or spiritual – and setting Don't Nod on a very different path. The game is set in Neo-Paris, essentially a dystopian, sci-fi version of the view the developers would have had out of their office window. In this dark future, memories have become a commodity – they can be traded, shared, erased, or even altered via a device called a sensen. The rich and powerful hoard knowledge and experience, while the poor are left with jumbled brains, slowly losing their humanity as they devolve into cannibalistic leapers.

With that set up, I can for once forgive the amnesiac protagonist trope. Hero Nilin wakes up as a prisoner in some sort of memory laboratory, having just had her mind wiped of all but scraps. Before long she's escaping the facility, rediscovering her past and, of course, turning out to be some kind of memory-power chosen one of the revolutionaries trying to bring down this corrupt society.

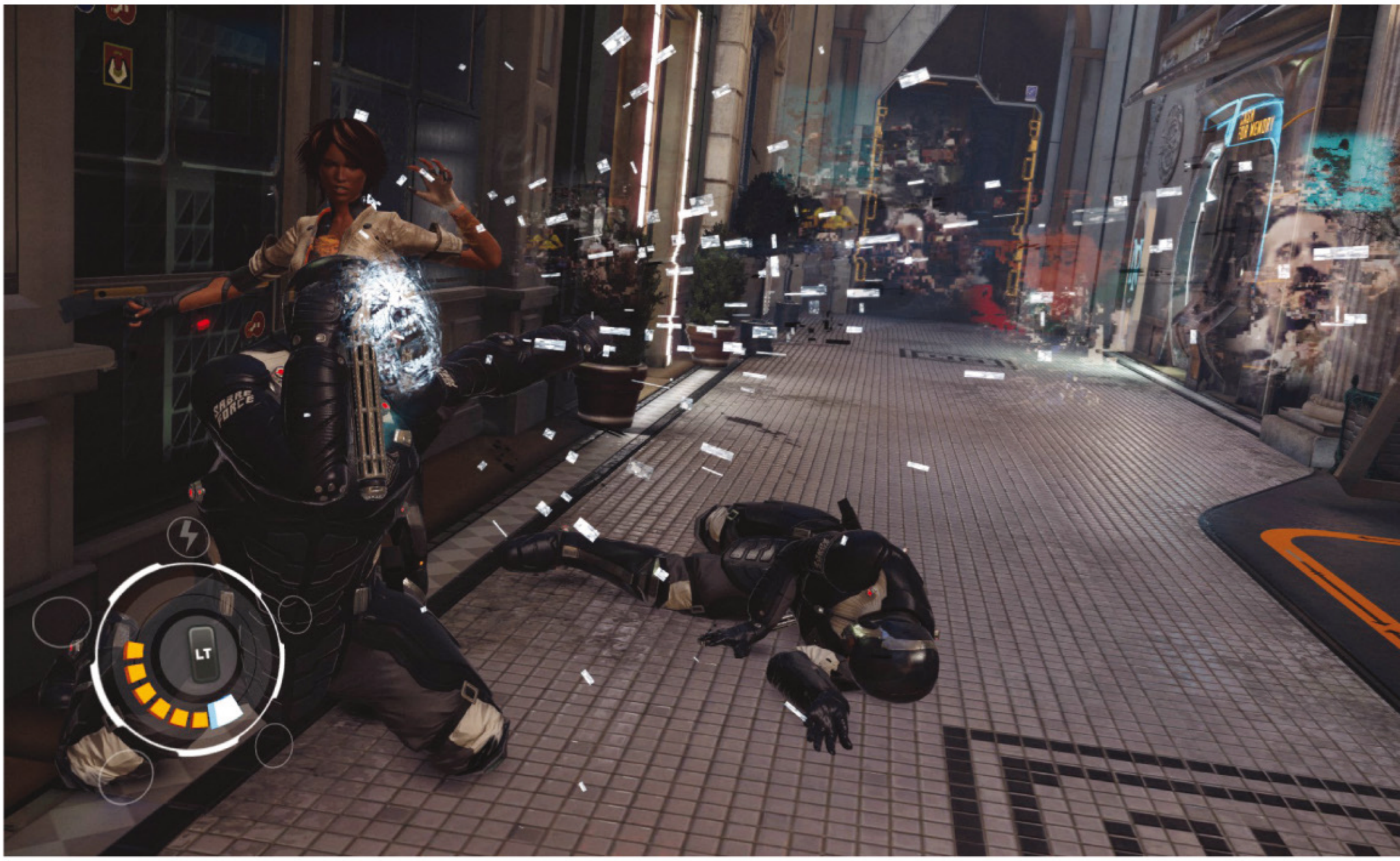


Mind games

I found *Remember Me* very charming when it first released – in my own mind palace, it has long enjoyed the position of underrated gem. Coming back to it in 2025, I can still see what I liked about it, but I find it a lot harder to forgive its obvious flaws. It's style over substance, and while the style has aged well, the substance feels more lacking than ever.

Despite the tampering with her brain, Nilin remembers her judo well. The game's martial arts battles with leapers and cops are the only element with any depth at all, and even then only relatively speaking. You button mash through basic combos, dodge and activate magic sci-fi powers once you've built up enough meter, and that's it. A system that lets you craft custom combo strings – loosely justified as another expression of memory control – is too lightweight to elevate it. Ultimately in motion it all feels distressingly weightless, like you're boxing with oven mitts on.

But really what you spend the majority of your time doing isn't even fighting – it's just moving through the city. When you're not walking down the street, you're performing straightforward



ABOVE: As you use your memory overload to blast cops' brains out, a holographic image of their screaming face displays over their helmets. Grim.

climbing sequences. It's the most aggressive of filler. The goal, clearly, is just to get you to drink in the visuals alongside some minor button pushing, but the game doesn't do nearly enough to justify holding your attention.

And yet... they are truly fantastic visuals. Even 11 years on from the game's original release, Neo-Paris is absolutely gorgeous, with that concept-art-come-to-life look so few games achieve. The effects of the sensen are similarly striking, represented as glitchy holograms that flow around character as memories are transferred or manipulated – or blasted out the front of a cop's face in one of the game's finisher animations.

French style suffuses everything, creating a unique feel in the sea of US-influenced action-adventure games. Every outfit is chic and glamorous, evoking Jean Paul Gautier's sci-fi costume design in *The Fifth Element*. Iconic landmarks pepper the city, breaking up the sleek and futuristic with elements of the old and gothic. Nilin herself is an ethereal runway model with a bottom the camera cannot get enough of – give her a cigarette to hold and she'd be ready to break a leading man's heart in a subtitled black-and-white art film.

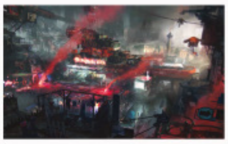
What's perhaps most disappointing about returning to the game, however, is rediscovering quite how little real world-building there is to bring together all this style and flair. The city of Neo-Paris simply doesn't make any sense whatsoever. The sensen device seems to be the source of all ills in this future, but there's precious little explanation of why. What is it about digitising memories that is causing society to collapse so rapidly? The answer is a vague 'it's a bad idea' with no real specifics.

Mind over matter

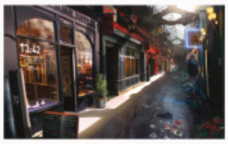
In Nilin's hands, memory tech is just magic, enabling a wide variety of thematically disconnected superpowers. Elsewhere, the loss of memories causes physical mutation into the long-limbed, deformed leapers. A metaphor, perhaps, for how memories empower us and define our humanity, but without any underpinning it all just feels a

MANKIND DIVIDED

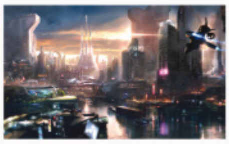
New technologies, same old class structure



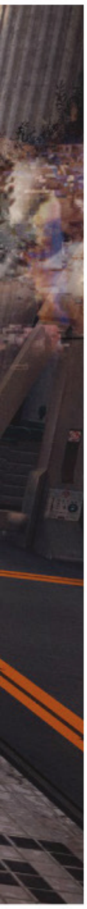
THE LOWER CLASS
In Slum 404, the memory-poor live out confused lives hunting for their next fix of positive memories – or else devolve into the leapers that dwell in sewers.

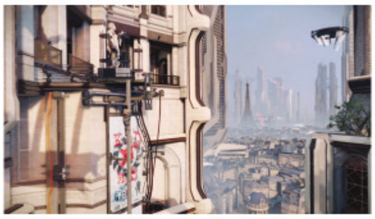


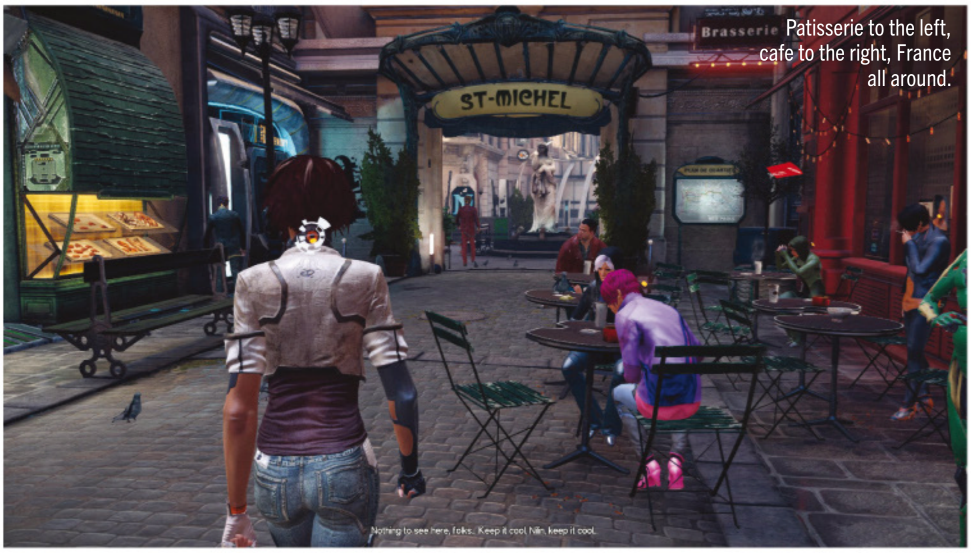
THE MIDDLE CLASS
Police barricades separate Slum 404 from the Paris of the better off, who live on clean, familiar streets and use robot servants to carry their shopping for them.



THE UPPER CLASS
True power comes with proximity to the company behind the sensens. These people live in luxury, but for some that just means getting lost in happy memories.





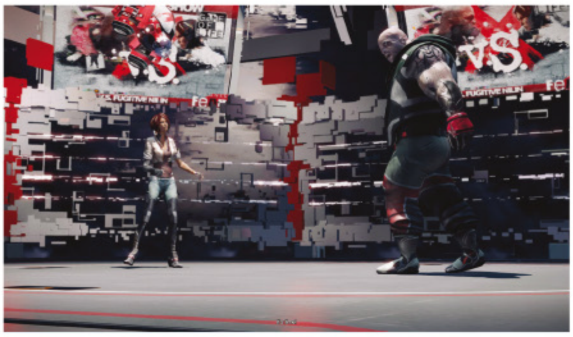


Patisserie to the left, cafe to the right, France all around.

Nothing to see here, folks.. Keep it cool Nilin, keep it cool.

TOP: The Paris skyline complete with Eiffel Tower. Magnifique.

RIGHT: Hulking thug Kid Xmas fights you while presenting his own TV show. Fun idea, but the battle itself is lifeless.



bit of a mess of ideas. In some cases, that leads to unintentionally silly or even offensive implications – why, for example, is real-life skin condition vitiligo a symptom of devolving into a monster? And if leapers are just victims of the system, why then am I spending so much of my time punching them in the face?

Every character and location is given a name either completely on-the-nose, or utterly nonsensical. A contact named Headache Tommy is found at The Leaking Brain bar. The revolutionaries are called Errorists, and seek to infiltrate the St Michel Comfortress. Funny and memorable, but none of it feels grounded in any kind of reality.

Whatever actual point the game is trying to make about our relationship with memory and technology is lost in the muddle. Is it a critique of social media? Is it warning us not to cling too tightly to the past? Or describing the dangers of trying to suppress your worst memories? Two years earlier we were watching *Black Mirror*'s *The Entire History of You* expertly pick apart our obsession with recording and rewatching our own lives – *Remember Me* takes ten hours and an awful lot more money to very beautifully fail to articulate anything anywhere near as clear.

Quality time

And yet there is one element that feels in harmony with the game's theme. At certain points in the story, Nilin is able to 'remix' the memories of key characters – diving back into an important moment in their lives, and tweaking parts of the scene to make it go a different way. In the present, their disposition is thus altered, demonstrating how core these memories and moments can be to our personalities.

One early sequence sees her hijack the mind of a bounty hunter about to bring her in. The killer is going for the reward on her head to pay for treatments for their husband, who's turning leaper – but by scrubbing backwards and forwards through a memory of him in the hospital, and adjusting small details, you create a version of events where he died instead. Returning to the present, the bounty hunter is now motivated to join forces with you and seek revenge for his death.

It's not a perfect concept, for sure. Executing the fairly simple puzzles takes a bit too much of going back and forth through dry footage, and there aren't enough of the sequences over the course of the game for Don't Nod to build on the idea. From a story perspective, it also seems morally dubious in a way the game has oddly little interest in addressing.

But there's the seed there of something really compelling and interesting. As you try different adjustments to the memory you get to see different outcomes of the scene, playing around with cause and effect until you get the outcome you want. It's easy to see the potential.

Two years later, *Life is Strange* would realise that potential, simply reframing the idea as time travel instead of memory hacking as protagonist Sam uses her powers to rewind and change the past. The result was critical acclaim, millions of copies sold, and a future for Don't Nod secured. So, *Remember Me* might be forgotten, but one of the strongest parts of it lived on, remixed. Maybe there's a point to be found in all this after all. ■

The ZX Spectrum Next is a modern update to the ZX Spectrum.

Old computers, new tasks

Classic computers can remain relevant in today's world thanks to modern hardware and software, as David Crookes discovers.

An intriguing photograph recently appeared in my Facebook feed, featuring an employee at a US doughnut shop using one of two Commodore 64s to process orders. The post featured the ageing computers positioned side by side in Hilligoss Bakery in Brownsburg, Indiana, and it garnered more than 1,300 comments, many of which echoed the old adage, "if it ain't broke, doughnut fix it!"

Upon closer examination, it became evident that the computers were running a program written in BASIC, a relatively primitive programming language by today's standards. But, as one poster asked, "how much computing power do you really need to sell doughnuts?" The vast comments thread also highlighted the continued use of Commodore 64s in various other contemporary settings.

There are reportedly instances of Commodore 64s being used in a US automotive repair shop and by an engraver. Nor are examples of retro computers in modern settings limited to the C64. DOS machines are being used to run a dry cleaners in Austin, Texas, while a Sinclair QL operates a greenhouse irrigation system in Romania. There are likely countless other examples, but are there truly any tangible benefits in preserving and using such outdated systems?

In many cases, using ancient machines to perform tasks in the modern day isn't a deliberate choice. It's more a matter of we've started, so we'll continue.

Hilligoss Bakery has been around since 1974, and it probably began using the C64s shortly after their release in 1982 and simply continued with them. Similarly, the US military's DEC PDP-11s were used for decades, while NASA software from the 1960s and 1970s persisted into the 2000s.

But there are advantages of using decades-old machines beyond inertia. For instance, they can be incredibly reliable and they don't require constant updates. Grab a computer from the 8-bit era and you can be almost certain that it won't be susceptible to viruses, either.

Retro machines are also great for storing private information such as passwords and financial details. Since files designed for retro computers can't always be executed on modern systems without emulation, there's a natural barrier.

To that end, using a less powerful and stable machine can be advantageous if the tasks are relatively straightforward. If all you require is a word processor, simple spreadsheet or basic inventory tool, for example, there's ample software available from many years ago that can perform these tasks effectively. As long as the floppy disks or tapes haven't degraded, you should be able to get up and running very quickly.

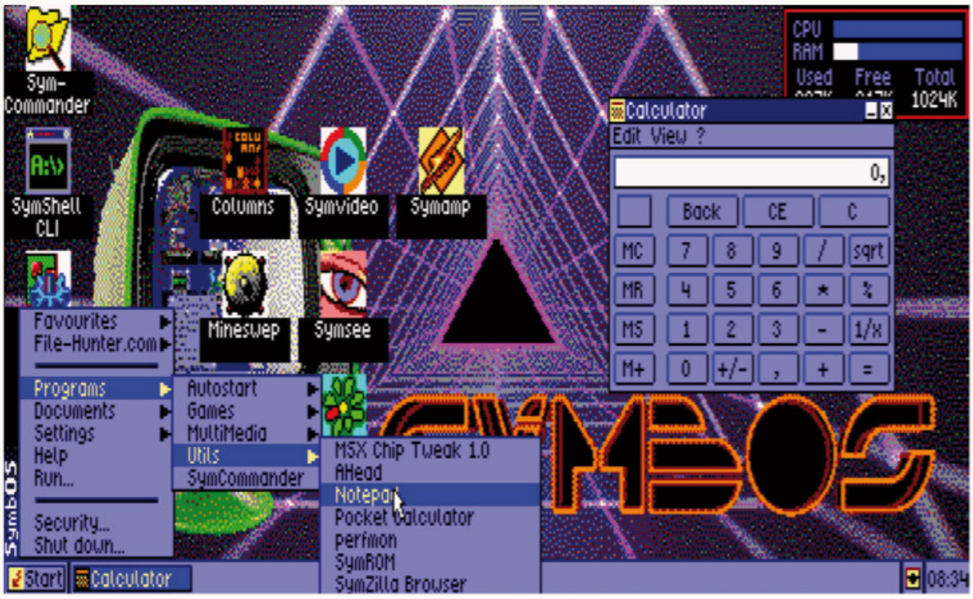
> "Over the years, hobbyist communities have emerged around many retro computers, and enthusiasts have resolved this very issue by writing apps and developing hardware that make older machines more relevant to users in the modern era."

Old meets new

But what if you want to revive a vintage computer and incorporate it into your personal or business workflow? It's all well and good grabbing an old copy of a word processor from eBay, rattling off a bunch of files and saving them to disk if you're entirely happy for that work to remain in isolation. If, however, you want to share it with other people or continue working on a modern machine, then you may find yourself in a bit of a pickle. How will you transfer those files from the old computer to the new?

Over the years, hobbyist communities have emerged around many retro computers, and enthusiasts have resolved this very issue by writing apps and developing hardware that make older machines more relevant to users in the modern era. You can now connect retro computers to modern monitors and use expanded memory, Wi-Fi connections and more reliable SD cards or hard drives. You can also use operating systems that replace command prompt interfaces with Windows-like GUIs and take advantage of more recently created software that lets you save files in a format that modern computers can recognise.

To achieve this higher level of integration, however, you will need to splash some cash. In some cases, you may also need to become more involved in your chosen retro computer's community by signing up to forums, joining Facebook groups and following the right people on social media.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SymShell CLI
Columns
Symvideo
Symamp
Minesweep
Symsee
CPU
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MSX Chip Tweak 1.0
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SymbOS
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Calculator
08:34

ABOVE SymbOS – here running on an MSX computer – has lots of modern software available.

That's because you'll require extra hardware – peripherals that aren't always readily available. In many instances, you're relying on a sole guy operating from a back bedroom to make a device from scratch while simultaneously managing all the responsibilities of life including family, work and friends.

The good news? Most of these community groups provide information about availability, waiting lists and alternative products and they are, for the most part, friendly and welcoming.

Hardware revival

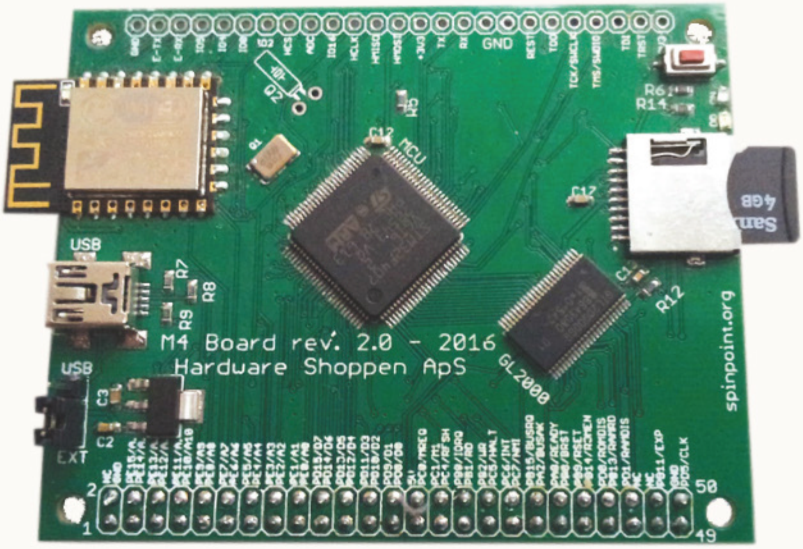
Community forums can also provide technical support that can be invaluable if you're looking to perform professional tasks that were often a pipe dream when the computers were in their heyday. At the very least, you may need some guidance on which wires to buy.

They can assist you in finding the necessary video cables to connect a wide range of retro computers to many different displays, eliminating the need to rely on increasingly rare and expensive CRT TVs or monitors. You're also likely to come across newer power supplies that should prove safer than the aging originals.

Beyond that, however, the types of available products will depend on the computer you're trying to modernise. If you want to tinker with an Amstrad CPC 464 or 6128, for instance, you could consider connecting them to Wi-Fi using the popular M4 Board expansion card. This allows you to use a web browser on a PC or Mac to drag and drop CPC files and programs onto the peripheral's SD card and make direct use of them on Amstrad's 8-bit machine.

This eliminates the need for floppy disks or tapes, and it also allows you to download programs from the web for use on the CPC. You'll gain access to more recently developed applications that were never released on tape or disk. Furthermore, if you also acquire expanded memory (enthusiast-created expansion packs for the CPC can offer up to 4MB of RAM), you'll be well on your way to creating a truly powerful machine.

The CPC 6128 also lets you connect ROM boards and have key


M4 Board rev. 2.0 - 2016
Hardware Shoppen ApS
spinpoint.org
GL2008
USB
USB
EXT
GND
4GB

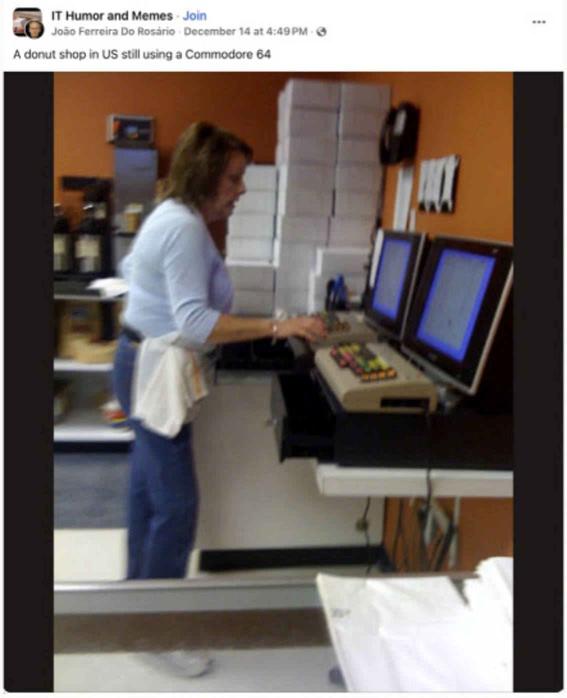
LEFT Amstrad CPC users have connected their PCs to Wi-Fi using the M4 Board.

software such as the acclaimed 8-bit word processor Protext on instantly loading ROMs. Additionally, you can connect an internal Gotek drive, a modern disk emulator that replaces traditional floppy disk drives. This enables you to save programs on USB flash drives and locate files by pressing buttons or turning a rotary dial until its name appears on the unit's built-in display.

Gotek drives are also available for the ZX Spectrum +3, Commodore Amiga, Atari ST and other retro computers. Since they lack moving parts, they've proven to be highly reliable. You can save files onto the USB flash drive and use them on your PC or Mac, making file transferring a breeze. Suddenly, you're transforming a retro computer from a dusty relic into a functional device.

But there's more. The Spectrum also has SD card-based storage solutions (such as the divMMC Future) along with the Specranet Ethernet interface and memory expansions. The Commodore 64 has RAM expansion units, accelerators and mass storage devices including SD2IEC, which replaces the Commodore 1541 disk drive.

The Amiga is blessed with FPGA-based and Raspberry Pi-based accelerators, and you can buy the recently released Indivision ECS V4, a frame rate converter that eliminates flicker on VGA monitors, flat screens and large televisions.



IT Humor and Memes · Join
João Ferreira Do Rosário · December 14 at 4:49 PM ·

A donut shop in US still using a Commodore 64

ABOVE This blurry image shows C64s being used in a US bakery.

Additionally, Plipbox allows you to connect Amigas to the local network via Ethernet while RapidRoad provides USB ports.

Modern adaptations

The deeper you explore each computer's community, the more you'll discover the remarkable advancements achieved by machines from the past. You'll also find numerous serious software applications that bridge the gap between older and newer computers.

Applications are still being developed for the CP/M operating system, which has been around since 1974. As an example, 2024 saw the release of the On File database management system inspired by the PC applications of the MS-DOS era. There's also a great cost-monitoring system called COSMOS that allows users to edit their daily income and monthly expenses and perform trial and error analyses.

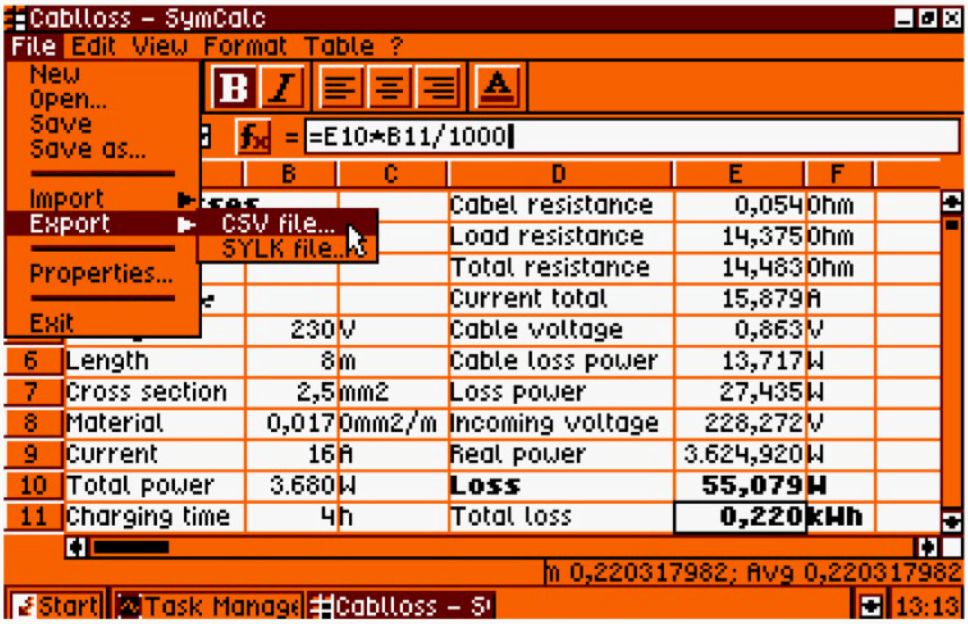
However, many serious applications are being created for retro computer operating systems that weren't even around a couple of decades ago. In the case of 8-bit computers, some of the most exciting developments revolve around the multitasking SymbOS initially released by Jörn Mika. It can be installed for free on a mass storage device such as an SD card.

"SymbOS has a full-featured Windows GUI with all kinds of elements," Mika told *APC*. "It also has true pre-emptive multitasking on an original 4MHz Z80, usually without any performance losses – you can run a music player, download and unzip a program and chat with your friends online, all at the same time."

SymbOS provides flexible memory management with support for up to 1MB of RAM, dividing the RAM into 256-byte pages and using the memory with maximum efficiency. But what makes it more interesting is its compatibility with many different platforms including the Amstrad CPC 6128, Amstrad PCW, MSX2 and Enterprise 128 with floppy disk drive.

"In 2024, we added support for the ZX Spectrum Next, Amstrad NC100/200 and SymbOSVM ports, the latter letting you run SymbOS in a near-native way on a Raspberry Pi or x86 machine," Mika said. With more than 60 SymbOS applications and games as well as tools and libraries for the development of your own applications in languages such as Quigs IDE and SymbOS C Compiler, there's a lot to get your teeth into.

For starters, you can launch the Notepad text editor to create and edit plain text documents, launch the standard and scientific Pocket Calculator and make use of SymbOS E-Mail, a Win9x-like email client that features an address book and lets you send and receive attachments.



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				Load resistance	14,375	Ohm
				Total resistance	14,483	Ohm
				Current total	15,879	A
		230	V	Cable voltage	0,863	V
6	Length	8	m	Cable loss power	13,717	W
7	Cross section	2,5	mm2	Loss power	27,435	W
8	Material	0,017	Ohm2/m	Incoming voltage	228,272	V
9	Current	16	A	Real power	3.624,920	W
10	Total power	3.680	W	**Loss**	**55,079**	**W**
11	Charging time	4	h	Total loss	**0,220**	**kWh**

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BELOW Created in 2024, SymCalc is a fully featured spreadsheet.

FlashFloppy
v3.38
GOTEK

LEFT Inexpensive Gotek drives work with many retro computers.

The year 2024 also brought SymCalc, a fully featured spreadsheet app that aims to bring the delights of Excel to machines running SymbOS. It includes more than 50 functions, absolute and relative cell references and fast auto-recalculation of cells. You can even import and export CSV and SYLK files.

"I wanted to show that large and powerful applications, which have even more functionalities compared to those from the 1980s, are possible in SymbOS," said Mika. "I'd always dreamed of programming a GUI-based spreadsheet application like Excel because I was always fascinated by those cell calculation algorithms, formulas and all that stuff. Now I want it to be the first part of a new office suite and a word processor is coming next, perhaps over the next year or two."

SymbOS also has file and disk management programs, a font editor and, in the past year, Star Chart. The latter lets users plot the sky with stars and planets for any time and geolocation. You can even use CPvM and run multiple CP/M virtual machines in SymbOS. "This lets you execute several business apps from the 1980s at the same time so long as they were made for the old CP/M operating system," Mika added.

Classic code

Other notable operating systems that keep retro computers ahead of the curve include Contiki, available for the Apple II, Atari ST, Commodore 64, Commodore PET, Oric and more. It comes with a lightweight text-based web browser, a basic email program and an FTP client. Meanwhile, AmigaOS 4 fully updates the classic Amiga OS, although you'll need to run it on a computer with a PowerPC processor, which isn't quite in the spirit of running modern apps on a classic machine.

That said, you can ditch the classic DPaint in favour of Personal Paint on the Amiga – there are versions for classic systems – or surf the web using iBrowse. You can scour Aminet.net, where new apps are being dropped on a monthly basis. It shows that you don't always need to use a new operating system to enjoy modern applications on a retro machine.

At the very least you'll find many devices and programs that will transfer files from one machine to another. OmniFlop, for example, can read and write multiple disk formats if you have a PC with a floppy disk controller. SamDisk, for Windows, Linux and macOS, can transfer disk images to and from a SAM Coupé and a modern computer, and you could also consider emulation – use your retro computer as intended, transfer the files, and use them within an emulator on your PC or Mac.

You could even go retro without really going retro. Lots of old software such as WordPerfect, Protext and Lotus 1-2-3 has been updated for use on modern machines. If you really want to go far back, consider WordStar, a word processor from 1978. It was reborn in 2023 as an open-source clone called WordTsar, developed by Gerald Brandt, who has used it to write science fiction novels.

"I missed the simplicity of WordStar and hated the complexity and bugginess of modern word processors," he told *APC*. "I wanted to go back to the simple display and keystroke commands I remembered, and there was nothing out there that did what I wanted so I wrote my own."

WordTsar has been updated for modern use so it has partial support for DOCX and RFT documents as well as WordStar 4 and WordStar 7 files. "WordTsar uses the abilities of modern processors and operating systems to reformat the entire document without stopping the user from continuing their work," Brandt says of one improvement.

This means that, regardless of your approach, you can still draw inspiration from the past. You can either seek to use more modern software on old machines or bridge the gap by using retro software on new machines. Either way, you'll be able to keep one foot in the past while moving forward. And have a bit of fun in the process ■

commodore 64

BELOW Modern peripherals and new software can help bridge the gap between retro and modern computers.

Pippinitis, apple.fandom.com/wiki/Taligent

KNOW HOW

Keen to remove embarrassing old posts from social media, Robert Irvine tries to…

Deep-clean his Facebook account

Aside from the occasional 'like', birthday wish and someone tagging me in a photo before I could stop them, it's been more than five years since I last posted anything on Facebook. My profile picture dates back to 2017 and several of my 'friends' are either estranged or sadly deceased.

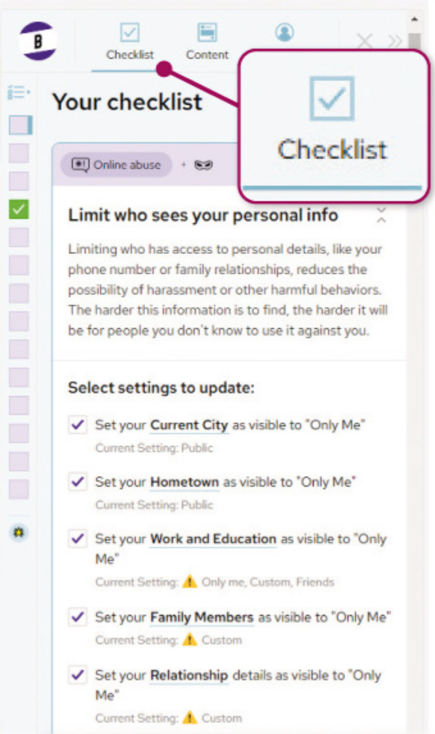
I'm not telling you this because I'm too cool for Facebook, and now hang out on TikTok, Discord or Bod, or whatever the 'in' thing is these days, but because I can't bring myself to delete or deactivate my account. Facebook is now generally something I'm no longer interested in, but occasionally have a peek at to see what people are up to.

When I do, I'm sometimes surprised by a 'memory' of something I posted many moons ago, such as a lame joke or a photo of me in a silly hat. Although I've locked down my Facebook privacy settings, I still worry about who else can see this nonsense.

So I was interested to read about a tool called Block Party (*www.blockpartyapp.com*), which promises to 'deep-clean' your social-media accounts of embarrassing content and recommend ways to secure your personal information.

Block Party costs US$20 a year, but it also has a free plan and lets you try paid-for features for seven days, without entering your payment-card details. I installed its extension from the Chrome Web Store (**tinyurl.com/APC543party**), clicked the option to start a free trial and tried to sign up for an account. But I was told that Block Party was "only available in the USA", and that I needed to join a waiting list for its Australian release.

Ignoring this setback, I chose to check Facebook through the free plan, and clicked the button to 'Start your first full scan'. Block Party scanned my profile and account settings, and presented me with its findings.



Your checklist

Limit who sees your personal info

Limiting who has access to personal details, like your phone number or family relationships, reduces the possibility of harassment or other harmful behaviors. The harder this information is to find, the harder it will be for people you don't know to use it against you.

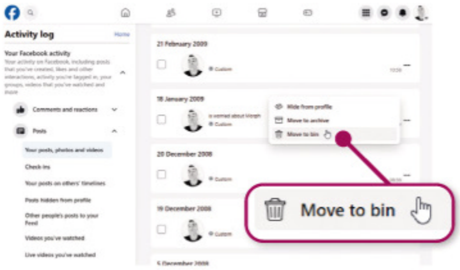
Select settings to update:

- ✓ Set your **Current City** as visible to "Only Me"
  Current Setting: Public
- ✓ Set your **Hometown** as visible to "Only Me"
  Current Setting: Public
- ✓ Set your **Work and Education** as visible to "Only Me"
  Current Setting: ⚠ Only me, Custom, Friends
- ✓ Set your **Family Members** as visible to "Only Me"
  Current Setting: ⚠ Custom
- ✓ Set your **Relationship** details as visible to "Only Me"
  Current Setting: ⚠ Custom

Block Party's privacy check is more useful than its restrictive deep clean.

On the Checklist tab (see screenshot above), it highlighted privacy settings that needed tightening, such as making certain personal info visible to 'Only me'; blocking friend requests and messages from strangers; and enabling two-factor authentication. All good advice, though essentially common sense.

I was more interested in the Content tab, where you can review all Facebook photos you've been tagged in and remove unwanted tags. Except I couldn't, because Block Party had blocked me from signing up for its trial. The 'Experience' tab, which lets you 'unfriend' people you don't like any more, was similarly locked behind an Upgrade button.



Robert manually removed embarrassing old Facebook posts and comments.

> "Although I've locked down my Facebook privacy settings, I still worry about who else can see this nonsense."

Still determined to clean up my Facebook account, I decided to do it myself. I went to my Settings page at **www.facebook.com/settings**, clicked 'Activity log' under 'Your activity' and chose 'Your Facebook activity' in the left-hand column.

I clicked Posts and was horrified to see details of everything I'd ever posted on Facebook – much more than I remembered – and every video I'd watched. Information about the latter was only visible to me, but my nonsensical public posts stretched back years.

Although I was tempted to tick the All box and purge the lot, I instead selected the most cringeworthy examples and chose 'Move to bin' (see screenshot above). Facebook also lets you 'archive' posts, in case you ever want to restore them, and use its filters to show only content from specific years.

Next, I clicked 'Comments and reactions', chose Comments and deleted the quips I'd made on other people's Facebook posts – Oscar Wilde, I am clearly not. I then selected 'Photos and videos you've been tagged in' and removed incriminating tags.

The whole clean-up process took about half an hour, but at least it was free with no restrictions. I doubt my Facebook friends will even notice any difference, but I'll certainly sleep more easily. ■

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